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THE CONSTITUTIONAL FACTOR IN GYNECOLOGY AND OBSTETRICS*

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IT SEEMS that almost every newly elected President has felt the urge to go back to first principles, to look through our old Transactions, and to become familiar with all the work this Society has done in the past. At any rate, that was exactly what I did, and I learned a great deal from this study and experienced a new respect for old achievements.

At the same time I was greatly interested to see how far Gynecology had traveled since that day in 1876 when our leaders first assembled in New York. At that time, and for almost thirty years after, Gynecology concerned itself exclusively with the pathology of the various organs of reproduction and concentrated practically all its efforts on perfecting the surgical treatment of the diseases of these organs. As Aschner puts it, the gynecologist was merely a uterologist.† The cause of disease was still a matter of speculation, and there was no unanimity of opinion except that it was due to some *external* force. The discovery of microorganisms offered the first hope of the solution of this problem. "Bacteriology came like a beam of light into the darkness" (Brown). The phenomena of disease were now readily interpreted as the effect of bacteria upon the cells of the body, and, to quote Brown once more, if any deviation from the normal or expected course of events occurred, it was attributed to some change affecting the microorganism. That man is not merely a culture medium, that the host, too, plays an important part in the interaction between the body and the infecting organism, was recognized only at a later stage.

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†Etymologically, hysterologist would be a more correct expression.

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Meanwhile the first timid beginnings of endocrinology established the truth that in some cases the cause of disease may reside *within* the body, and so our eyes were drawn from the diseased organ to the diseased organism, from the cell to the patient as a whole. We were then impressed by the fact that patients differed from each other in many respects. This was by no means a new discovery. A hundred or more years ago our medical forefathers spoke of "temperaments" as distinguishing criteria, and these denominations were replaced, in the first half of the nineteenth century, by such terms as diastheses and dyscrasias, until, in 1858, Virchow's Cellular Pathology drove all these remnants of the humoral pathology of Hippocrates, Aristotle and his followers into the limbo.

Now, however, the observations made on the endocrine glands, investigations into the nature of the vegetative nervous system and studies of metabolism deflected medical thought away from a purely morphologic conception towards a biologic point of view, and today the study of constitution approaches the problem of individual differences from a wider and more scientific angle. An amazingly large amount of work has already been done in a very short time, particularly in the field of internal medicine where Martius, Krauss, Brugsch, Bauer and others led the way. In the steadily mounting literature with specific reference to gynecology and obstetrics, the monographs by Sellheim, Aschner, Mathes and especially the encyclopedic treatise by A. Mayer demand attention. In America, our fellow member, Charles P. Noble was the first, and as far as I know, the only one to write specifically on the constitutional factor in our specialty.

But this branch of science is still so young and the problem so intricate and controversial that we are only at the threshold of a new and enticing territory. The very definition of the word "constitution" presents difficulties because this term, though in daily use, does not connote the same meaning to everybody. Primarily, Constitution implies something inherited, something that was established when the chromosomes of the parental gonads first united. The combination of hereditary traits which determine the outer form, the physiologic functions, and the mental processes of an individual, forms the basis of his constitution and represents his "genotype."

According to some writers, notably Tandler and Bauer, the genotype remains essentially unchangeable though slight variations may occur later.

Opposed to this conception of the immutability of constitution is the view held by the majority of observers, that external forces have the power of producing more or less pronounced alterations and modifications of the genotype. These accessory influences may make themselves felt in utero, but for the most part, they operate in postnatal life. They comprise prematurity, birth injuries, unsuited artificial feeding, the so-

called children's diseases and other severe infections, climate, unhygienic living conditions, lack of air and light, malnutrition, etc., and their influence may, in point of time, extend until about the appearance of puberty. The product of heredity, then, plus the influence of environment combine to give to the person his true individuality, his constitution. This wider concept of constitution is termed the phenotype of a given individual.

The phenotype need not be evident at once; it may not put in appearance until puberty or even the climacterium when the dominant features of the constitution come into preeminence. Even the superficial lay observer then notes that this or that person has "changed completely."

Let us further remember that the inherited potentialities of constitution react in a particular way to stimuli of any kind and, thus may create in one person a marked resistance, in another an undue susceptibility to disease. In short, "constitution is the morphological, physiological and psychological resultant of the properties of all the cellular and humoral elements of the body; this resultant is determined by the laws of heredity and by the influences of environment" (Pende).

CONSTITUTIONAL TYPES

Whether we adopt this or any other definition, we must admit that the constitution is unique for any given individual, that no two persons can have exactly the same constitution.

There are, however, enough similarities to permit us to classify all human beings into various groups or types. The literature contains many such classifications based on the assumption of two, three or more fundamental types with numerous subdivisions, combinations and blendings. The simplest groupings are, perhaps, anthropometric divisions into the long-thins and short-thicks (Draper) or the slender, medium, and stocky (Bell). The French School (Sigaud, Chaillou, Mac Auliffe) laid emphasis on function and distinguished four types: *type respiratoire, digestif, musculaire* and *cerébral.* Krauss, Martius, Krehl and others saw in constitution the sum total of resistance and counteraction to environment; and to yet another group of workers the accentuation of mental processes appeared essential in the classification of individuals (Kretschmer).

As most authors have found it desirable to coin designations of their own in order to stress the most distinguishing trait, there has sprung up a highly complicated nomenclature which renders the study of constitution somewhat confusing. In our special field of inquiry, however, we may avoid this multitude of terms which are based largely upon observations on *men,* and attempt to study the differences existing between *women* by adopting Tandler's classification into hypotonics, hypertonics and, between them, those of normal tonus. It may well be that at some future time physicochemical determinations (Saltykow) or other

highly refined methods of examination (Mathes) will simplify matters. For the present we must perforce be satisfied with less exact definitions. This at once applies to the term, "normal tonus." Nobody can tell accurately just what is a "normal" woman. We can only have a sort of intuitive conception. Rafael's Sistine Madonna impresses us as normal, and so does, in the plastic art, the Venus of Medici. The "normal" woman is of moderate height; her lower limbs are short in proportion to the trunk, and the thighs are in close apposition; the bones are delicate, the wrists and ankles slender, the breasts round and firm; the pelvis is broad, the arch of the foot not very high; there is no hair on the body except on the pubes and, less copiously, in the axilla; the face is small, the neck small and round; the costal angle is wider than 90 degrees; the outer contour exhibits soft curves, and the buttocks are firm and prominent; the skin is thin, tight, and elastic. These are only some of the physical characteristics of the normal woman, but such perfect types are rare. Together with such a physique, the normal woman functions, reacts to environment, and responds to mental and psychic stimuli in a way which, again prompted more by artistic feeling than by exact measurement, we call harmonious. Other things being equal, such a woman will menstruate normally; she will conceive readily, pass easily through pregnancies and labors, and have abundant milk supply in the puerperium. The chief endowments of this ideal in total human development, according to W. W. Graves, seem to be symmetry, proportion, harmony, and adaptation of structures and functions. As physicians we seldom come in contact with these types in a professional way because their very attributes seem "to supply them with those peculiar qualities which enable them to adapt themselves well to their environment, to resist disease, to survive and to attain long life."

The other two types are the ones which we find most frequently in our patients.

The hypotonic type includes asthenia and infantilism as well as the "intersexual type" of Mathes.

Among the first to describe the asthenic woman was our fellow member, Richard R. Smith. Although his paper, presented before this Society in 1906, dealt specifically with enteroptosis, he did not fail to notice certain general characteristics which went hand in hand with the downward displacement of the abdominal viscera. He observed that these women exhibited (1) a flabbiness or hypotonus of the body tissues; (2) a lack of vital energy; (3) a more or less pronounced backwardness in development. "If we examine such patients," he continued, "we note a long, narrow, shallow, and usually more or less collapsed thorax, flaccid abdominal walls, usually a prominent abdomen, changes in the curves of the spine, a general relaxation and flabbiness of the muscular and connective tissue structures, and, as a rule, an abnormal lightness in weight. There is a ptosis of the abdominal viscera and, perhaps, a

displacement of the pelvic organs. Combined with these objective symptoms we find a list of subjective phenomena the principal ones of which are: general weakness, an inability to carry on work without exhaustion, nervousness, oftentimes melancholy, constipation, and disturbances of digestion and other functions, such as those of menstruation and urination. Such patients commonly have backache, pain in the lower abdomen in one or both sides, a bearing down sensation, leucorrhea."

One year after this paper by Smith there appeared the classical treatise by Stiller which affixed the term Asthenia to this type of human beings. Parenthetically, asthenia is not a new word. It has been in use for more than a hundred years and has always been employed to denote a sickly, feeble, pathologic condition. Viewed from the angle of constitution, asthenia, however, does not necessarily mean sickness. Many asthenics may be healthy all their lives (Hofstaetter) and even live longer than so-called stronger people (Saltykow). In the female, asthenia does not often manifest itself before puberty, and it usually ceases after the menopause coincidentally with the accumulation of fat. It is, however, undeniable that during the reproductive age the demands of life are too great for the large majority of asthenics. In all likelihood it is something connected with the sexual life which disturbs their equilibrium (Hofstaetter); but there may be stress of some other kind under which their latent weakness often appears (Wood). Such women form the greater part of our gynecological patients.

The best known example of the asthenic woman is the Venus of Boticelli. She corresponds closely to the description given to us by Smith. While the stature of asthenic women is usually below the normal, a considerable percentage must be classed as tall. In any case, the lower extremities are disproportionately long. The face is long and narrow, the skin thin and transparent, the neck is long and the shoulders slope downward; the clavicles are prominent with marked supra- and infraclavicular depressions, the scapulae which in the "normal" woman lie flat on the thorax, project outward, the epigastric angle is acute, and the ribs slant steeply downward. The posture of the asthenic with its high dorsal kyphosis and low lumbar lordosis is quite characteristic. ("Gorilla" type posture of Dickinson.) Stiller considered the floating tenth rib as a definite and constant finding in asthenia, but this is no longer generally accepted. In this connection, attention should be given in gynecological circles to the scapular classification in relation to constitution to which W. W. Graves has devoted years of painstaking investigation. A relatively large number of asthenics, according to Graves, bear the type of scapula designated "scaphoid." Hernias and flat feet are also frequent findings.

The configuration of the thorax and the general laxity of muscular and connective tissue structures account for the pendulous abdomen and the ptosis of all viscera. The latter again gives rise to obstinate

constipation, and this in turn to disturbances of nutrition. Constipation is also a prolific source of gynecological ailments, for the long retention of feces in the ampulla recti may cause a thickening of the sacrouterine ligaments which may lead to posterior parametritis and, secondarily, to uterine displacements. The concomitant congestion of the pelvic vessels may cause an irritation of the pelvic peritoneum which, finally, would result in dysmenorrhea, menorrhagia, vaginal discharge, and pain in coition. That this syndrome might eventually lead to dyspareunia, frigidity, and vaginismus is not surprising, *for the somatic asthenia has its counterpart in psychasthenia and hyperesthesia.* Mayer who graphically describes this course of events, also points out how such patients are apt to fare when they consult a physician. There are two rather common eventualities. Complaining of some gynecologic symptom such as backache, the examiner on finding no gross abnormality may declare the patient healthy but imaginative, and this unsatisfying attitude may eventually drive the woman into the hands of a cultist or a quack. More frequently, however, a gynecological ailment is diagnosed and local or surgical therapy instituted instead of searching for the underlying constitutional cause which would call for treatment of constipation, inanition, or exhaustion. This is no mere speculation, but a matter of real practical importance. With rare unanimity all students of the question speak of the increasing frequency of asthenia even though Aschner's estimate of 70 per cent may be regarded as too high. Let us further remember the numerous instances where such patients, after the first suggestive effect of an operation has worn off, come back with the same complaints.

Infantilism represents a separate type in which the development of the body has been arrested as a juvenile stage. Consequently, the infantilistic individual exhibits physical and psychical traits reminiscent of the child. This expresses itself externally in the youthful appearance, the round chin, the proportions of the skeleton, the cylindrical thorax and the course of the ribs which run at right angles to the spine. The secondary sexual features are incompletely developed; the hard palate is narrow and high; the front teeth are widely spaced ("trema" and "diastema"). In the genital sphere the hypoplasia of the external organs is often very marked. The configuration of vagina and cervix presents a typical picture. The small uterine body lies in pronounced anteflexion, retroflexion or lateroflexion or exhibits other signs of arrested development (arcuate, rudimentary uterus, etc.). Both the external and internal os are small. The tubes are too long and tortuous;* the ovaries are small and smooth from lack of ovulation. The culdesac is abnormally deep, and this, together with a primary weakness of the pelvic floor, may give rise to prolapse of uterus or rectum in children and nulliparous women; in such instances a spina bifida occulta is often

*This has long been recognized to be one of the etiologic factors of tubal pregnancy.

found on x-ray examination. The small pelvis with its narrow arch, its funnel-shaped outlet, and its insufficient inclination completes the picture, not to mention the infantile appendix, the elongated bladder, the small heart, and the narrow aorta. The endocrine system is profoundly affected, particularly in the sense of hypofunction of the pituitary body and the ovaries.

Psychically the outlook on life, the instability of the nervous system, the unwilling response to sexual demands (frigidity, dyspareunia, vaginismus) are further evidences of stunted growth.

The hereditary cause of infantilism can in many cases be traced to alcoholism or syphilis of the parents or to pre- or postconceptional exposure of the mother to x-rays. In postnatal life anything that retards the development of the infant may become responsible for infantilism, be it directly through poisons or infectious diseases or by way of disturbing the endocrine balance.

Infantilistic girls begin to menstruate late; they are apt to have long periods of amenorrhea or suffer from dysmenorrhea. The hypoplasia of the soft part renders defloration difficult, and this in turn may produce vaginismus. If not actually sterile, they may have frequent abortions. Even if pregnancy continues, the minor disturbances of gestation appear in an exaggerated form. The rigidity of the underdeveloped uterine wall renders fetal motions which normally are below the threshold of conception, excessively painful. Cervical and perineal lacerations are the rule, and so are complications on the part of the contracted pelvis. In the puerperium there is a noticeable lack of resistance against loss of blood or infection, and the milk supply is generally insufficient. As such women are very apt to emerge from labor with a pendulous abdomen, enteroptosis and prolapse, it is quite comprehensible that to them the reproductive function represents a veritable *via dolorosa*, and that they strenuously object to having more children.

In clinical gynecology, most of us will have to confess to our failures, and to the unreasonableness, of dilatation or incision of a "pin hole os." Congenital retroflexion, likewise, should be a touch-me-not. "In about one-third of all virginal retroflexions the painstaking observer will find stigmata of infantilism," says A. Mayer whose admirable work is freely quoted in this paper.

The frequent association of infantilism and tuberculosis is of diagnostic and prognostic importance. The same is true of the combination of infantilism and the status thymolymphaticus. The small size of heart and aorta, and the lability of the vasomotor mechanism renders any narcosis or loss of blood in operations very hazardous and may account for many a sudden surgical death.

More frequent and even more distressing than the other two is the combination of infantilism with asthenia. What distinguishes the two types is this that infantilism is underdevelopment of *form* whereas asthenia is underdevelopment of *function* (Mayer).

I cannot leave the subject of infantilism without mentioning that there are quite a few individuals who give the general impression of a pronounced infantilism, yet behave and function in a perfectly normal way. They are invariably far below the average size, look like children, have delicate bony structures and a proportionately small pelvis, and possess a sunny, happy disposition. On careful examination none of the dwarfed primary or secondary sexual characteristics of true infantilism can be detected. They pass through pregnancy, labor, and puerperium without marked difficulties and frequently are even exempt from the usual birth injuries. This group must be regarded as miniature editions of the normal woman and not be confused with the hypoplastic type which has been discussed in the foregoing.

The "intersexual" or masculine type does not seem at first sight to belong in the same category with asthenia and infantilism; for many representatives of this type are above the average in height, and all are characterized by a strong skeletal build and pronounced facial features. The distribution of hair is characteristic. The lower legs, the forearm, the perianal region, the buttocks are covered with hair, and the pubic hair extends from the mons pubis along the linea alba towards the umbilicus in the form of the triangle which is rather typical of males. Frequently, too, the eyebrows meet and there is a more or less faint suggestion of a mustache. In more severe cases, there is hair on chin, thigh, upper arm, back, and breasts. This abnormal hirsutism is the reason why Aschner designates this type as "hypertrichotic."

The shoulders are broader than the pelvis; the latter is, as a rule, of funnel shape and with a greatly reduced inclination, and always there is a free space between the thighs.

The ovarian function is diminished. In consequence, there is often a hypoplasia of the genitals as in infantilism, and frequently a combination with the asthenic hypotonus.

It was Mathes to whom we owe the classical description of this category and the term "intersexual type." He explained its occurrence by the fact that originally the *anlage* of every organism is bisexual and that only at a later stage of development the predominance of one or the other sex gland leads to the determination of masculinity and femininity, respectively. In the type under discussion this differentiation remains incomplete; hence the individual remains intersexual.

Such patients are subject to dysmenorrhea, frigidity, and dyspareunia, symptoms which in the last analysis are due to disturbances of the unstable nervous system. They rarely have complete orgasm; hence, there results a chronic hyperemia of the genital organs (Fekete) which in turn may be responsible for cystic degeneration of the ovaries, menorrhagias, and tender sacrouterine ligaments and thus, finally, to dyspareunia and sterility.

Disturbed ovarian function upsets the equilibrium of the endocrine system which explains other clinical symptoms.

The intersexual individual suffers, consciously or unconsciously, from her physical incompleteness. She may rebel against manifestations and functions of her femininity such as menstruation which appears to her as unaesthetic, or marriage which impresses her as humiliating. On the other hand, she may yearn to be fully a woman and passionately wish for a child which, for physical reasons, is only too often denied her. Her whole life is a sum of physical and mental conflicts. This psychic component has been studied particularly by Kretschmer who classifies these patients among the "schizophrenes." From a gynecologic point of view it is interesting to note that L. Fraenkel and his pupil Geller have found infantilistic genitalia in a large percentage of schizophrene women; microscopically, there were few follicles in the small ovaries, and the uterine mucosa showed low epithelia and narrow glands without signs of activity.

While in mild forms of intersexualism, happy domestic relations and, particularly, conception and childbirth may bring about a satisfactory solution, the majority of cases have to go through the martyrdom of life as best they can, until in advanced age the disharmonies of the torn personality dissolve themselves spontaneously (Mayer).

The hypertonic category though numerically smaller than either of the other two groups, is composed of several widely different types.

There is, first, the physiologic giantess, that is to say, an individual in whom all the physical characteristics of a normal woman appear in an exaggerated form. Some of Rubens' models represent this sort of superwoman. Her height does not seem as excessive as that of the masculine type, because her body is perfectly proportionate and harmonious; and though her panniculus adiposus is well developed, we call her fleshy rather than stout. One feels that she has an intense joy in living without the usual physical handicaps, and that her large pelvis, exceeding the average measurements by an inch or more in each diameter, safeguards easy labors. Whether the mental development is on a par with the physical, I am unable to tell from my own few observations or the scanty references in literature; but one unconsciously connects Catherine the Great or, perhaps, Catherine de Medici with this type of hypertonus and hyperplasia.

Another kind of gigantism impresses us by its lack of harmony whether this be in the form of a general obesity or, on the contrary, the poor development of adipose tissue. Disturbances on the part of various endocrine glands are here at work, notably the hypophysis and the adrenals. Since such glandular disorders are but very rarely acquired even if they manifest themselves in later life, the constitutional nature of this pathologic gigantism seems definitely established. The chapter of endocrinology has been studied so intensely that we may confine ourselves to a mere mention of acromegaly and other disorders. It is significant to note in this connection that competent observers claim that abnormal obesity is constitutional in the majority of cases. Van Noorden esti-

mates familial incidence of obesity in 70 per cent, Bauer in 88 per cent (Silver and Bauer). "This perversion of metabolism is the work of a *congenital* factor already present in the fertilized ovum, that destines the organism to accumulate fat." This assumption seems to find confirmation in the interesting experiments by Strandberg who transplanted fat from the abdominal wall to the dorsum of the hand. It is known that the back of the hand rarely becomes fat, yet in these cases a distinct, local, unilateral obesity occurred at the site of the transplant. This indicates that the transplanted abdominal wall, though separated from its previous nerve and blood supply, retained its lipophilia, that is, its irresistible tendency to accumulate fat.

As Mayer points out, it is not always easy to differentiate between physiologic and pathologic overgrowth of the body. In general, the "normal" giantess is apt to begin menstruating early, the pathologic giantess late, because in her there is usually a hypofunction of the ovaries demonstrable. Many such giantesses have small hearts; loss of blood in labor or operation, narcosis or infection are, therefore, rather dangerous.

UNSOLVED PROBLEMS

I am well aware that the classification of constitutional types presented in the foregoing, is incomplete, that it does not take into account the numerous blendings and variations which occur but cannot easily be put on paper, that it leaves out exceptional cases which seem to fit into no category. But, after all, this classification is only to be a temporary expedient to illustrate this plea for greater consideration of the constitutional factor in gynecology and obstetrics. It will and must be changed as our experience grows and unsolved problems have been cleared up. And there are many such questions that clamor for answer. Why is it, for instance, that certain individuals and certain races show a marked tendency toward formation of keloids? Why, on the other hand, do abdominal incisions sometimes break open completely in the absence of infection or any other tangible cause such as syphilis, cachexia, or advanced age? Fear or excitement may in some women bring on menstruation prematurely or suddenly check an existing one, but has no such effect on others. In pregnancy a slight jarring may lead to bleeding and abortion in one case while in another an automobile trip from coast to coast will not interrupt gestation.* It is well known that red haired women frequently have a postpartum hemorrhage even though the delivery was spontaneous and skillfully managed. There are, also, instances of famil-

*Such individual differences have attracted attention for many, many years. In A. E. von Siebold's Handbuch der Frauenzimmerkraukheiten (Vienna, **2**: 211, 1829) I found the following passage: "Most women who have bleeding spells in pregnancy, have a certain disposition to hemorrhages though the nature of the latter cannot always be determined . . . . some women show no effect from even the most severe external traumatism while others bleed abundantly after a very mild injury . . . . *weakly, asthenic constitutions* (italics mine), flabbiness and weakness of the uterus preeminently predispose to uterine bleeding." This reference of more than one hundred years ago has been inserted merely for its historical interest. I realize that in explaining obscure phenomena by constitution, we substitute for the unknown factor another unknown or but imperfectly understood quantity.

ial postpartum hemorrhage that can only be interpreted as constitutional. Recently, Embacher reported a striking instance of this kind. The mother had nine normal deliveries, and no obstetric complications were known of in either the maternal or paternal immediate family. The four daughters ranged in age from sixteen to twenty-five years; the pelvic measurements were normal, the deliveries spontaneous, the children healthy, and the placentas showed no abnormalities. Yet, each of these four sisters had a severe postpartum hemorrhage in every one of their confinements.

As a final illustration of unsolved problems of constitution, the occurrence of familial icterus of newborn may be cited. In a personal observation of this kind, the mother, a healthy woman of normal constitution, gave birth to four children; the first, a girl, is alive and well; of the following three, all boys, each died of severe jaundice exactly fifty hours after birth in spite of competent pediatric treatment.

From these few examples which can easily be multiplied, it is seen that our knowledge in this field is still very fragmentary.

PRACTICAL ASPECTS OF STUDY OF CONSTITUTION

On the other hand, the study of constitution has already yielded many valuable new viewpoints in gynecology and obstetrics—largely in the sense of diagnosis and prognosis but also, to a certain extent, in the question of therapy.

To choose a few instances at random, we have learned to recognize the constitutional nature of certain cases of dysmenorrhea, frigidity, dyspareunia, and vaginism. Menstrual pain had been considered since the days of Marion Sims, as being due to obstruction at the internal or external os. Today we can admit this etiology only in a very small minority of cases. Hence the multitudinous dilatations and discissions of former years have been substituted by a more causative therapy which aims at reducing the psychic hypersensitiveness and quieting the irritable vegetative nervous system in constitutional inferiority. The surgical enlargement of the vaginal entrance for the cure of vaginism now appears obsolete. Congenital retroflexion is almost always associated with other signs of infantilism and does not call for indiscriminate operation. The complaints of such patients are not caused by any displacement but are due to their constitutional deficiencies, and we cannot hope by surgical means to transform the hyperesthetic organism with its low threshold for any sort of pain or other unpleasant sensation. But even in acquired retroflexion, restraint from operative overzeal is in order. Asthenics quite commonly present a multitude of complaints among which backache, pain in the ileo-inguinal region, sense of weight, dysmenorrhea, and vaginal discharge are conspicuous. On examination, only insignificant findings are, as a rule, elicted. Thoughtful surgeons have long warned against the routine removal of the so-called "chronic"

appendix in such cases. Gynecologists, too, are beginning to weigh cause and effect more carefully. Operation for the uterine displacement alone will at best yield but a temporary improvement. What these patients are most in need of is rest in bed, a high caloric diet, treatment of constipation, some passive exercises, and a suitable support. Only if there are anatomical changes in the retroflexed uterus as evidenced by menorrhagias, or if the displacement is associated with prolapse, is surgical therapy clearly indicated.

There are cases where this new appreciation of constitutional factors makes us recognize our own therapeutic limitations more keenly. Thus, in an adult woman of a marked intersexual type we are forced to realize that her gynecologic complaints are not amenable to any gynecologic treatment. Patients of this sort should be referred to a neurologist for psychotherapy so that they may be tided over until the menopause automatically makes an end to their psychical conflicts and physical complaints.

The rôle of constitution in sterility has been made the subject of intensive investigation. Berkow studied 69 sterile women without any physical anomalies in the genital sphere, in whom the Huhner test showed motile spermatozoa; of these 69 patients, all but one were constitutionally abnormal (eunochoid, obese, infantilistic, etc.) Of the 25 cases investigated by Meaker, almost one-fourth failed to conceive for reasons of faulty constitution.

Whether or not constitution influences the ordinary disturbances of pregnancy, is still undecided. It seems, however, that hyperemesis occurs more frequently in asthenics. Primary inertia has, of course, various causes; yet, it is observed most often in infantilistic and asthenic women who at the same time are refractory to pituitary extracts and other oxytocics. It is, therefore, not surprising that in this class of patients confinements as a rule, are harder (Givatoff), particularly if one also takes the condition of pelvis and pelvic floor into consideration. Isaksohn found rupture of membranes before onset of labor in 35 per cent of asthenics and none in normal women; duration of first labor of more than 24 hours was noted in 20 per cent of normal and 50 per cent of asthenic patients.

Eclampsia seems to be the only complication in pregnancy which shows a predilection for the normal type. The patients are as a rule primiparae and below thirty years of age, and almost always well nourished, florid, stocky women which makes one suspect a relationship between this form of toxemia and constitution.

Such differences in susceptibility to disease have often been noted. It is, for instance, generally accepted that hypotonics are unduly susceptible to tuberculosis while the normal type shows a propensity to cancer. Regarding cancer, the view now prevails that it is a local disease which, however, is based on a constitutional disposition (A. Fraenkel). From

a thorough analysis of 858 cases, Benedetti concludes that cancer prefers the so-called constitutional and physiologic optimum; and among the 81 patients with cancer of the uterus studied by Takata and Suzue, almost all exhibited a "strong" constitution with a costal angle of more than 90 degrees.

Other differences in liability to disease have been mentioned in the body of this paper. I refer in particular to the dangers from narcosis, hemorrhage and infection to which some types are more exposed than others. In a thoughtful paper on predestination in disease, W. Langdon Brown discusses variations in proclivity to disease based on inborn errors of metabolism, idiosyncrasies, endocrine balance, factors which are intimately connected with our subject, yet had to be curtailed for lack of time and space. Here, too, may be mentioned in passing Aschner's contention that the complexion has a great deal to do with individual reactions. Blond persons have a much more sensitive skin to sunlight, x-rays, counterirritants, etc., than dark ones. A laxative which acts only mildly on the latter, is a purge for the light skinned. Aschner points out that the old physicians knew that the pigmentation of the skin is a criterion of the "humors" beneath. For instance, the milk of blondes is less concentrated than that of brunettes.

The study of constitution permits us to a certain extent to predict the course of the climacterium. The perfectly normal woman "glides, as it were, insensibly, from the reproductive age into the menopause, practically without any physical or psychical upheavals" (Wiesel).

In the woman of the intersexual type the change of life imposes new hardships: severe vasomotor disturbances, all sorts of "nervous" symptoms, insomnia, depression alternating with excitement, vertigo, gastrointestinal upsets, pain along the course of vessels. This sort of patient is likely to lose weight, in contrast to the normal woman who is apt to become stout, and to exhibit markedly masculine traits (hair on face, deep voice, etc.)

The infantilistic patient with a pronounced hypoplasia of her endocrines need not have any change of life in the strict sense of the word. Her development has remained arrested all her life.

The asthenic individual is likely to suffer severely during this epoch. All symptoms due to her ptosis become aggravated, the constipation is more obstinate, abnormal and painful accumulation of fat may interfere with locomotion, and all this distress is quite apt to continue for years.

Knowledge of the constitution of the patient will furnish us with certain valuable hints in our practical work. It will stay our hands from a number of unnecessary operations. It will also lead us to better technical methods in operating. The most impressive example is prolapse in children or nulliparous women. Most patients of this sort are infantilistic asthenics. They have a hypoplasia and weakness of all the tissues of the pelvic floor and the ligaments of the uterus. The lack

of firmness, elasticity and resistance of the connective tissue fibers explains the frequent failure of the ordinary type of prolapse operations in these cases (Offergeld). Even more important, however, is the abnormal depth of the culdesac which in infantilistics, extends all the way down to the pelvic floor. Therefore, only a method which provides for a complete obliteration of the culdesac, promises permanent result in this class of cases.

Appreciation of constitutional influences also helps us to prevent gynecologic ailments. We may, for illustration, once more refer to prolapse in hypotonics. Knowing beforehand the flabbiness of all structures in such patients, we would pay particular attention to a prenatal régime of good feeding and graded exercise and give even greater care to these points after the birth of the child. These patients must rest in bed longer than others and take systematic and supervised exercises of the muscles of the pelvic floor and abdomen. In labor they must be guarded against unnecessary exertion, pain, and undue prolongation of the second stage by means of "twilight sleep," local or general anesthesia, and a liberal use of episiotomies and low forceps. In the puerperium they should not be allowed to nurse, lest there result a lactation atrophy which might become permanent and lead to sterility. The use of a suitable corset or abdominal support is of great importance.

TREATMENT OF CONSTITUTIONAL INFERIORITY

Is it possible to affect therapeutically a constitution which is inimical to the patient's health? To a certain extent, yes. Some infantile uteri may grow after marriage, and some dysmenorrheas. may disappear (Mayer). Perhaps, organotherapy, despite its present disappointing results, may yet improve matters if instituted sufficiently early in life. Several personal observations have somewhat restored my optimism. As endemic myxedema points to the influence of soil and water, as change of occupation sometimes depresses ovarian action and tropical climate often stimulates it, we are led to hope that we may accomplish results by changing the environment. Nor should we forget the possibilities which diathermy and other means of inducing local hyperemia offer as to the growth of the genital organs.

An asthenic, thin, hypotonic individual can be rendered much stronger and more resistant by such drugs as iron and arsenic, by stimulating her appetite and increasing her body weight, by hydrotherapy, by ocean baths or, on the contrary, by the stimulation of altitude. The sovereign therapy, however, is muscular exercise both active and passive, systematically graded and suited to the individual needs (Goldscheider), and the avoidance of harmful influences (alcohol, tobacco, infections, trauma, excessive emotions, physical and mental overwork). In the constitutionally obese, on the other hand, dietary and pharmacologic treatment (iodine, mercury, thyroid extract, saline purgatives), to which Aschner adds the use of venesection, are in order. "Thus many

cases of obesity associated with scanty menstruation, sterility or climacteric disturbances can be improved or even cured'' (Aschner).

Sometimes pregnancy produces a spontaneous cure of infantilism, and one is delighted to see that such women positively blossom out.

PREVENTION OF CONSTITUTIONAL DEGENERACY

Much more important than the therapy of inferior constitutions is their prophylaxis. We must bear in mind that the law of natural selection no longer applies universally to mankind, and that civilization tends to preserve the unfit. Something should be done to check the endless stream of these ill adapted individuals and to improve the constitutional quality of the race. Borchardt's contention that persons with particularly undesirable congenital features should not be permitted to propagate, and that in less severe cases one should at least see to it that the sexual partner does not exhibit the same stigmata, will very likely remain a pious wish. Yet, there is a wide and promising field for preventive measures. An encouraging beginning has already been made in our prenatal care in which, I believe, this country has taken the leading part. If prenatal care were universal and uniformly thorough, the total abolition of congenital syphilis with its deleterious effect on the constitution of the offspring is quite conceivable. Neither does it seem altogether fanciful to imagine that the baneful influence of lead, alcohol and other poisons on the parental gonads can be eliminated, or at least restricted, with increasing enlightenment of the people. Other factors leading to a constitutional improvement of coming generations will no doubt be evolved. The experiments by Freund and Schmitt appear to me highly suggestive. These authors exposed 229 pregnant women to ultraviolet radiation and contrasted their offspring with the children of 222 ''unradiated'' mothers. They found that the children of the first group were a little longer and heavier than those of the second group, that they less often developed rachitis and presented a higher phosphate level in the blood. Better obstetrics, generally speaking, will avoid many of the harmful influences which act upon the constitution at the time of birth. ''The present generation of grandparents and parents is beyond our control so far as prophylaxis is concerned. Not so, however, with the grandparents and parents of future generations'' (McCurdy).

Nor must our vigilance cease after the child is born. In our introductory remarks we have included in our definition of Constitution the environmental factors which may act unfavorably upon the hereditary traits of an individual. As W. Langdon Brown expresses it, the seed is not all-important . . . . the soil must also be considered. A multitude of hygienic deficiencies may affect the growing child, and, according to Hering, *everything* that happens to an organism during its life, leaves ineradicable traces in the memory of the matter. It is no mere accident that the children of the proletariat in crowded tenements

are shorter in stature than those of more privileged classes, just as a lack of fundamental hygiene was probably responsible for the shorter growth of man in the middle ages as anyone knows who has seen medieval armor in Continental museums.

Fortunately there are nowadays in addition to individual endeavor many social agencies capable of utilization in the solution of this problem. The juvenile courts, playgrounds, recreation centers, home-finding agencies, fresh-air farms, etc., are all important and valuable measures.

"It is only through a great public awakening to the fact that every child, rich or poor, has an inherent right to that individual care which will develop his potentialities to their highest point that we can hope to make material progress. This awakening must come through the physician. It is he alone who is capable of understanding the complex make-up of the child and the significance of apparent deviations from the normal. It should be his province to direct the detail of those environmental influences which make or mar the future; this with normal children, as a preventative of hypoplasia, and, with hypoplastic children, that the tendency to further degeneracy may not only be arrested but that regeneration may be encouraged" (McCurdy).

CONCLUSIONS

A short survey of any intricate subject necessarily remains sketchy. Thoroughness has to yield to brevity. But certain general facts and principles emerge clearly.

We started out to study the constitutional factor in gynecology and obstetrics and we found that this study involved questions connected with anthropology and embryology, pharmacology, biochemistry and clinical medicine, pathology and eugenics. With so many links connecting gynecology and obstetrics with all the other fields of medical endeavor, there can no longer be talk or fear lest specialization lose its contact with the general science of Medicine from which ours as well as every other specialty has sprung.

Medical science, again is not an isolated phenomenon but, as Seelig aptly says, "the development of medical thought and medical activity in any country, or during any era, is only a reflection of the general culture, mode of thought, habits and general reaction to environment on the part of the people under consideration."

The study of constitution, therefore, accomplishes two results of great general import: it links our specialty once more with Mother Medicine and establishes our place as gynecologists in the life of the nation.

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METROPOLITAN BUILDING.

PELVIC ENDOMETRIOSIS AND TUBAL FIMBRIAE*

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ADENOMYOMA, adenomyosis, endometrioma, müllerianoma, endometriosis, müllerianosis and endosalpingiosis are a few of the names which have been introduced by various writers to indicate misplaced müllerian mucosa (of uterine or tubal type) in or upon the pelvic structures. In some instances this ectopic tissue can be shown to have arisen by direct extension from the mucosa lining the uterus or tubes, but more often its origin is due to some other phenomenon. In the majority of the latter cases, implantation-like patches of müllerian mucosa are present on the surface of the various pelvic structures, often with a varying degree of invasion of their host. Although peritoneal endometriosis can occur without an associated ovarian endometriosis (including endometrial cysts of that organ), more often both conditions are present in the same individual.

It is the purpose of this communication to consider the following phases of pelvic endometriosis:

1. The structural similarity between peritoneal endometriosis and peritoneal carcinomatosis of ovarian origin, suggesting a like development of the two conditions.

2. The relation between ovarian and peritoneal endometriosis.

3. The indications: (a) that frequently müllerian mucosa on the surface of the ovaries and peritoneum is primarily, in part, the result of a

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local reaction to some substance escaping into the pelvic cavity from or through the patent tubes; (b) that this substance is in solid form and (c) that menstrual blood is one cause of this reaction and therefore contains this substance.

4. The evidence that the müllerian mucosa on the surface of the ovaries and peritoneum, caused by some substance escaping through the tubes, may arise entirely from a differentiation of tissue "in situ."

5. The evidence that the foreign substance (cells) causing the local reactions on the surface of the ovary and peritoneum is derived from müllerian mucosa and is sometimes held captive in the scar of the wound caused by them and there continues to grow, as cancer cells grow when implanted in these situations.

In the life history of pelvic endometriosis it is natural to consider the part taken by the mucosa of the uterus and the tubes especially that of the tubal fimbriae since they lie exposed in the pelvic cavity when the tubes are patent, the tubes usually being patent in patients with pelvic endometriosis.

During the study of tubal fimbriae a form of fimbrial endometriosis was found which apparently arose from a differentiation of their mucosa into endometrium-like tissue. To this condition the name *primary fimbrial endometriosis* might be given. This differentiated and activated mucosa may invade the wall of the tube, the mesosalpinx and also by direct extension reach the surface of the ovary and even cause endometrial cysts of that organ. By its reaction to menstruation, fragments of müllerian mucosa are disseminated into the pelvic cavity. Therefore the menstruating mucosae of primary fimbrial endometriosis are active foci for the spread of müllerian tissue and may be one cause of misplaced müllerian tissue on the surface of the peritoneum and ovaries, and of endometrial ovarian cysts.

THE STRUCTURAL SIMILARITY BETWEEN PERITONEAL ENDOMETRIOSIS AND PERITONEAL CARCINOMATOSIS OF OVARIAN ORIGIN

The proof that cancer invades its host is absolute because this extension of the cancer can be definitely demonstrated. In like manner uterine and tubal epithelium, at times, invades the uterine and tubal walls, thus giving undebatable evidence as to the source of the ectopic müllerian mucosa in these cases.

When a "secondary" cancer is found, which can be shown not to be continuous with the assumed primary tumor it may or may not have arisen from the growth of cells transported from the primary cancer through well-recognized channels. The chain of evidence, indicating that secondary cancer is ever of metastatic origin, is broken and therefore this evidence is at best circumstantial. The same is true for the origin of misplaced müllerian mucosa not continuous with that lining the uterus and tube.

A study[1] of the lesions of the peritoneal carcinomatosis so often associated with ovarian carcinoma, demonstrates that the majority of them apparently arise from the repair of injuries to the peritoneum caused by cancer cells which had escaped into the peritoneal cavity and lodged on the surface of its serous membrane, together with the continued growth of these cells in this situation. The life history of these carcinomatous implants may be divided into the following stages.

1. The escape of cancer cells into the peritoneal cavity from the ovarian tumor.
2. The transportation of these cells to their site of implantation.
3. The reaction of the peritoneum injured by cancer cells lodging on its surface.
   (a) Fixation of the cancer cells by fibrin.
   (b) Organization of the fibrin by fibroblasts alone, or by both fibroblasts and vascular endothelium forming granulation tissue.
   (c) Transformation of the organized fibrin into connective tissue.

The form of the implant varies with its age, the reaction of the peritoneum to the injury, and the activity of the cancer cells. The mature implant may consist of cancer cells embedded in the thickened peritoneum or encapsulated on its surface. In other instances it resembles a polyp wholly or partially encapsulated. The polyp may be sessile or pedunculated. Implantations in adhesions frequently occur. All the implantations just described may be designated as those of the foreign body type.

There is one form of peritoneal cancer found in patients with peritoneal carcinomatosis, associated with ovarian cancer, for which a true metastatic origin might be questioned; that is, the uncovered or non-embedded tumor which is attached to or spreads over the surface of the peritoneum like a primary growth arising from the mesothelium in this situation. Since the mesothelium and the cells of the ovary in which the cancer arose, undoubtedly had a common ancestor, i. e., the celomic epithelium, it might be inferred that whatever causes a differentiation of ovarian epithelium into cancer might effect a like differentiation of its closely related peritoneal mesothelium. This would be an example of the multicentric origin of cancer in closely related structures, well recognized by pathologists and recently stressed by Robinson[2] in his discussion of the origin of primary and secondary ovarian cancers. If this type of peritoneal cancer is in any way related to the ovarian tumor it might be claimed that it arose from the stimulation of the mesothelium by some substance escaping from that tumor into the peritoneal cavity. On the other hand, the cancer cells might be grafted on the surface of the peritoneum like small skin grafts or the cells may have been covered with fibrin which did not become organized and therefore disappears. For these reasons I have been tempted to consider at least some instances of this form of peritoneal cancer as implantations of the skin graft type.

We have abundant proof that cells may escape into the peritoneal cavity from the ovaries, tubes and even the uterus. What happens to them? Are they all absorbed without any evidence of a peritoneal re-

action? The distribution of the pelvic peritoneal lesions of endometriosis is such as to indicate the possibility of their origin from the above mentioned sources. The reaction of the peritoneum is often similar to that stimulated by foreign material lodging on its surface. Various stages in this reaction may be found corresponding to those encountered in the embedding or encapsulation of foreign bodies introduced into the peritoneal cavity of lower animals and in the implantation of cancer in human beings. Therefore, the deposits of müllerian mucosa on the surface of the peritoneum often present exact counterparts of the embedded implants of cancer just described, except that the cancer cells are replaced by müllerian epithelium and often the stroma by müllerian stroma. In other instances the müllerian mucosa is attached to or spreads over the surface of the peritoneum like a primary growth which might have arisen from a differentiation of the mesothelium. These lesions are similar to the uncovered deposits of cancer on the peritoneum which were designated as possible implantations of the skin graft type.

Do the implantation-like lesions of peritoneal endometriosis represent localized metaplasias of the peritoneum caused by some specific stimulant escaping into the peritoneal cavity from the ovaries, tubes or uterus, or are they the result of the repair of injuries caused by cells, escaping from the above-mentioned sources, which lodged on the surface of the peritoneum and there continued to grow in the way we believe peritoneal carcinomatosis may often arise? Have all implantation-like patches of pelvic endometriosis a similar origin? Are some derived entirely from a metaplasia or differentiation of tissue "in situ," and others from a local reaction along with the retention and growth of transplanted cells? It is obvious that these questions cannot be answered to the entire satisfaction of all, any more than can similar questions in regard to the origin of peritoneal carcinomatosis. It is quite possible that in both instances some of the peritoneal lesions may have arisen from the embedding or grafting of transported cells and others from a differentiation of tissue "in situ." A comparative study of peritoneal endometriosis and peritoneal carcinomatosis must convince one that the peritoneal lesions in the two conditions often have a similar origin.

THE RELATION BETWEEN OVARIAN AND PERITONEAL ENDOMETRIOSIS

Ovarian endometriosis may be divided into three groups.

1. Müllerian-like mucosa on the surface of the ovary, often invading that organ, without the presence of an endometrial cyst or a hematoma.

2. Endometrial cysts wholly or partly lined by tissue of the histologic structure of müllerian mucosa, often with similar mucosa on the surface of the ovary. I believe this group often represents a later stage of the preceding one.

3. Hematomas in which typical müllerian-like mucosa is lacking in their lining. I have hesitated to classify any of these hematomas as müllerian (endometrial) unless they were adherent and there was evidence of a previous rupture or perforation and endometriosis was present in the structures adherent to the ovary at the site of the perforation of the hematoma.

In the first two of these three groups there is nearly always (if not always) an associated peritoneal endometriosis. It is obvious that the ovarian and peritoneal endometriosis in these cases must either have a common origin or else one is derived from the other. It also must be obvious that some of the peritoneal endometriosis found in the second group was probably present before the ovarian hematomas had developed and therefore did not entirely arise from the rupture of the latter. Observations made at operation, together with the microscopic examination of tissue removed, demonstrate that müllerian mucosa on the surface of the ovary and likewise lining these cysts may, by direct extension invade adherent structures and that the contents of these cysts at times escape into the pelvic cavity. All stages in the rupture of these cysts and the repair of the resulting injury have been observed at operation. One is convinced therefore that at least some of the adhesions present in these cases arise from the escape of the contents of the hematomas and the repair or closure of the perforation. The presence of müllerian mucosa in these adhesions, as well as the distribution of other peritoneal foci, speak for the origin of at least some of these lesions from the contents of the ovarian hematoma escaping into the peritoneal cavity.

In a paper published by me[3] in 1921, on hemorrhagic cysts of the ovary and their associated peritoneal adenomas of endometrial type, the origin of the adenomas was regarded as derived from menstrual blood escaping from the perforation of the ovarian hematomas and likewise from endometrial tissue on the surface of the ovaries. Both the metaplasia and implantation theories were considered in the discussion of the development of the peritoneal lesions from this source. Up to that time I had not attempted to determine the origin of the müllerian mucosa (including the hemorrhagic cysts) in the ovary, but believed that the principal, if not the sole cause of the peritoneal endometriosis in these cases, was the implantation of epithelium carried with the contents of the ovarian hematoma escaping into the pelvic cavity or conveyed with menstrual blood from the endometrial tissue on the surface of the ovary.

King,[4] in a recent paper on the origin of endometriosis of the ovary and its associated peritoneal endometriosis, states that the lining of the ovarian cysts "arises probably by metaplasia from cells which are present in the ovary and not from cells of another organ by a peculiar process of transplantation." He believes that the peritoneal lesions "are produced, in almost every case, by the implantation of epithelium from tarry cysts."

Novak,[5] in a recent paper on pelvic endometriosis, made the following statements in his summary of its etiology and histogenesis. "The celomic heteroplasia theory explains the lesions more logically and has wider applicability than any other, in so far as the actual cause is concerned, but that implantation must, almost certainly, play a part in the dissemination of the process once it has begun" . . . "In other words, I do not believe that endometrial cysts are the result of implantation of tissue carried from the uterus through the tubes at menstruation, but rather that some other factor brings about the further differentiation of germinal epithelium into endometrium" . . . "On the other hand, once endometrial cysts have developed in the ovary, their frequent perforation, with the setting-free of tissue which in this

case may be viable, together with the direct invasive growth of endometrium into adherent tissues, would seem to offer a logical explanation for the common clinical pictures found.'' In discussing the perforative tendency of endometrial cysts, Novak states, ''The physiologic hemorrhage which takes place from the endometrial lining of the cysts at the menstrual periods would seem to offer the logical explanation for this perforative tendency associated as it must be with an increased tension of the cyst contents.''

It is evident that Novak believes, as I do, that tissue set free by the menstrual reaction in the endometrial lining of these ovarian cysts, is sometimes *viable* and escaping into the pelvic cavity may become implanted on the peritoneum. Why should not similar tissue, set free by the menstrual reaction of endometrial mucosa in other situations also sometimes be *viable* and capable of becoming implanted on the peritoneum, or even on the surface of the ovary, should it escape into the pelvic cavity? I still believe, as I did in 1921, that peritoneal implantations frequently arise from endometrial tissue in the ovary (including endometrial cysts) and by later studies I am convinced that they may result also from the menstrual reaction of endometrial tissue on the surface of pelvic organs and structures other than the ovary, and likewise from tissue escaping from or through the patent tubes. Peritoneal endometriosis frequently occurs without demonstrable müllerian mucosa in the ovaries as will be discussed later. Therefore the peritoneal endometriosis associated with endometriosis of the ovary may or may not have been entirely derived from the müllerian mucosa in that organ.

PATENCY OF THE FALLOPIAN TUBES AS A FACTOR IN THE ETIOLOGY OF MÜLLERIAN MUCOSA ON THE SURFACE OF THE OVARIES AND PERITONEUM

With an increasing ability to recognize the early peritoneal lesions at operation, I soon realized that they frequently occurred without demonstrable müllerian-like tissue in the ovaries. I naturally looked for some possible source other than the ovaries, from which material capable of causing peritoneal endometriosis might escape into the peritoneal cavity.

The distribution of the peritoneal lesions was carefully noted at operation, and at the same time observations were made of the normal relation of the fimbriated ends of the tubes to the ovaries and other pelvic structures. The early ovarian lesions were found almost exclusively on the lateral and under surfaces of that organ, situations more favorable than the mesial surface of the ovary for the retention of any solid material escaping from the patent tubes.

In the cases of peritoneal endometriosis without demonstrable müllerian tissue in the ovaries, the distribution of the peritoneal lesions occurred in situations easily soiled by material which might have escaped from the patent tubes, and occurred especially in the natural peritoneal pockets or folds.

I was impressed then, as I now am, with one outstanding feature of patients with müllerian-like tissue within or on the surface of the ovaries, and on the peritoneum, and that is, the tubes are usually patent. Up to

1922 I had studied the conditions found in 71 patients with implantation-like lesions of müllerian tissue on the peritoneum. Fifty-six of these were associated with ovarian hematomas. The abdominal ostia of the tubes in all of these cases were apparently patent. In fourteen of the others the tubes also were seemingly pervious. In the remaining one case, bilateral hematosalpinx was present with a peritoneal lesion on the posterior surface of the uterus in close proximity to the occluded end of the adherent left tube, thus suggesting an intimate relation between the two.

At that time an opportunity was afforded for the microscopic examination of more material. An attempt was made to ascertain the exact structure of the müllerian mucosa in the ovary and peritoneum as a possible indication of its source. It was found that the müllerian-like mucosa in the peritoneal and ovarian lesions, including the lining of the ovarian hematomas, could be divided into three histologic groups, those resembling tubal mucosa, those lined by or containing "uterine mucosa" and a third group containing both tubal and uterine mucosa which I believed might have arisen either from the implantation of both tubal and uterine epithelium or might have represented a transition from one type to the other. A fuller presentation of the data just briefly given may be found in the paper published[6] in 1922.

Patent tubes play an important rôle in the etiology of misplaced müllerian mucosa on the ovaries and peritoneum and therefore it must be due to something escaping from or through the tubes into the peritoneal cavity, which is capable of causing patches of müllerian mucosa in these situations either from a differentiation of tissue "in situ" or from the implantation of tissue (including epithelium) derived from the uterine and tubal mucosa.

THE ORIGIN OF MÜLLERIAN MUCOSA ON THE SURFACE OF THE OVARIES AND PERITONEUM FROM A DIFFERENTIATION OF THE GERMINAL EPITHELIUM AND OF THE MESOTHELIUM CAUSED BY SOME SPECIFIC STIMULANT ESCAPING FROM OR THROUGH THE PATENT TUBES

In 1906 Taussig[7] published a very interesting paper on ectopic decidua formation. He believed that it did not arise in misplaced müllerian tissue, but that it was the result of a local irritation caused by substances escaping from the placenta through the lumina of the tubes. He called attention to the superficial character of these lesions which suggested a surface irritation, and also noted their distribution. They occurred with the greatest regularity on the surface of the ovary, on the peritoneum of the culdesac and that covering the rectum and the posterior surface of the uterus. Because the decidua occurred in patches he believed that the stimulant was not in solution but consisted of cellular detritus. From my own study of ectopic decidua I am convinced that some of them are due to a decidual reaction in misplaced müllerian mucosa present prior to the pregnancy. Granted that Taussig's theory

is correct in many instances, as well it may be, the following deduction might be made from it, which may have a bearing on the etiology of pelvic endometriosis. If ectopic decidua in the peritoneum sometimes arises from the specific stimulation of its mesenchymal tissue by cellular detritus escaping through the tubes of the pregnant uterus, then peritoneal endometriosis might sometimes arise from the specific stimulation of the peritoneal mesothelium by cellular detritus escaping through the tubes of the nonpregnant uterus. There is such a marked similarity in both the distribution and the general character of the two peritoneal lesions that a similar origin might be considered.

During my entire study of endometriosis I have constantly considered its possible development from the specific stimulation of tissue "in situ" as well as its origin from the reaction due to epithelium lodging and subsequently growing on the surface of the peritoneum. The former phase of the subject was discussed in my first paper[3] on the etiology of peritoneal endometriosis associated with endometrial cysts of the ovary, published in 1921, and was again presented in 1926. In the latter paper[8] emphasis was laid on the etiology of pelvic endometriosis from menstrual blood escaping from or through the tubes as well as from endometrial tissue in the ovaries and other pelvic structures. Reasons were given for believing that, if pelvic endometriosis arose from the specific stimulation of the mesothelium by some substance in menstrual blood, this substance must be in solid form, rather than that there were scattered throughout the pelvic peritoneum patches of potential müllerian tissue, which, under the specific action of menstrual blood, developed into müllerian mucosa.

In 1928 Novak and Everett,[9] as a result of their study of the cyclical and other variations in tubal epithelium, made the following statements in regard to the nature and significance of the tubal "secretion." "That this peculiar cellular 'secretion' of the tube, some of which may readily enter the peritoneal cavity, may in some way be related with the etiology of endometriosis." "There is much difference of opinion as to the correctness of the menstrual regurgitation theory of the causation of endometriosis but the fact that the tubes are commonly patent lends much weight to the view that, whatever the cause may be, an important factor must be some substance derived from these open tubes." In the same paper they described an interesting phenomenon, i. e., the extrusion of nuclei from the secretory cells into the lumen of the tube during the premenstrual stage of the menstrual cycle. They state that this is seen in many lower animals but its significance is not known. I had seen these clumps of nuclei in the lumen of tubes, but did not appreciate their origin until Novak and Everett presented their paper. It, then, occurred to me that these extruded nuclei might readily escape into the peritoneal cavity and might even be viable and capable of becoming implanted on the surface of the ovary and peritoneum of human beings, or they might be one of the specific solid stimulants causing a differentiation of germinal epithelium and peritoneal mesothelium into müllerian mucosa.

The following year Hofbauer,[10] in a paper on the etiology of decidua formation in the peritoneum during pregnancy, called attention to the marked resemblance which exists between the topographic distribution of ectopic decidua and endometriosis. He was inclined to favor the theory that, "given the proper stimulus, the

local peritoneal elements, both mesothelial and mesenchymal may possibly take some part in the formation of ectopic endometrial tissue.'' ''This stimulus according to Cunningham may be the presence of blood.'' ''It is common knowledge that a reflux of menstrual blood through the tubes into the pelvic cavity occurs not infrequently.'' ''This blood may be the etiologic element involved in that stimulation of the mesothelium and mesenchyma which results in endometriosis in some instances.''

I have purposely studied the peritoneal changes resulting from the escape of blood into the peritoneal cavity during tubal pregnancy. While I encountered many interesting peritoneal reactions I have never observed any simulating peritoneal endometriosis. I have also carefully looked for peritoneal endometriosis in patients who have previously been operated upon for tubal pregnancy and have not seen any except postoperative endosalpingiosis about the tubal stump.

Novak[6] in his recent article on pelvic endometriosis discusses the possible stimuli causing the further differentiation of such tissues as the germinal epithelium or the pelvic peritoneum into actual endometrium. He states that ''presumably they are chiefly of endocrine nature.'' ''The only other explanation would be that an adventitious factor is added by some substance emanating from the ends of the tube.'' ''Whether this is menstrual blood or whether, perhaps, it is something secreted by the so-called secretory cells of the tubes, is of course a matter of speculation only in the present stage of our knowledge.''

Certainly many of the patches of müllerian mucosa on the surface of the ovaries and peritoneum suggest an origin due to the differentiation of the germinal epithelium and mesothelium into müllerian mucosa just as deposits of cancer in these situations sometimes suggest such an origin. The only other explanation for these uncovered deposits of müllerian mucosa and cancer in these situations is that they are implantations of the skin graft type as has been discussed.

From my studies of pelvic endometriosis I am quite convinced that the stroma is often derived from the tissues of the organ or structure invaded by the müllerian epithelium. If mesenchymal tissue can be converted into müllerian stroma by the presence of müllerian epithelium, why should it not be possible to convert mesothelium into müllerian epithelium by a specific stimulant?

In endosalpingiosis[11, 12] arising from the outgrowth of the tubal mucosa, in the healing of tubal stumps, the activated and often differentiated mucosa may give rise to typical endometrial cysts of the ovary (5 cases) and also typical endometrial tissue in the abdominal wall or any other structure adherent to the stump. As will be shown later in this paper, the mucosa of tubal fimbriae at times becomes differentiated and activated, causing lesions including endometrial cysts of the ovary similar to those arising from the activated mucosa of the tubal stump. A like differentiation of tubal mucosa occasionally occurs in other situations than the fimbriae and in endosalpingiosis of nonoperative origin.

If tubal mucosa under certain conditions is converted into müllerian mucosa of uterine type one might infer that mesothelium, another

derivative of the celomic epithelium, could become differentiated into either uterine or tubal mucosa if given the proper stimulant.

It is evident that abundant circumstantial evidence has been presented indicating that pelvic endometriosis may sometimes arise from the stimulation of the tissues of the surface of the ovaries and peritoneum by some substance escaping from or through the patent tubes during the menstrual life of women. Also there is like evidence that this substance is frequently present in menstrual blood and is in solid form.

THE ORIGIN OF MÜLLERIAN MUCOSA ON THE SURFACE OF THE OVARIES AND PERITONEUM FROM THE IMPLANTATION OF EPITHELIUM ESCAPING FROM OR THROUGH THE PATENT TUBES

Since peritoneal endometriosis may occur without ovarian endometriosis, the former is not always secondary to the latter. When the two occur together, they may be identical in their histologic structure and apparently of the same age thus suggesting that they may have had a common origin in these cases.

There is strong circumstantial evidence that the müllerian mucosa in the two situations frequently arises from the actual implantation of epithelium escaping from or through the patent tubes.

1. As has already been presented these lesions seem frequently to arise from some substance escaping from or through the tubes.

2. The histologic structure of the ectopic mucosa caused by this substance escaping from the tubes is the same as that of the mucosa from which the substance was derived, just as the histologic structure of the lesions of peritoneal carcinomatosis is the same as that of the primary growth.

3. Since this substance is evidently often in solid form, it must consist either of cells or of cellular "detritus."

4. The general histologic structure of these patches of müllerian mucosa simulates those of peritoneal carcinomatosis of implantation origin.

5. Bits of müllerian mucosa have been successfully transplanted in the peritoneal cavity of lower animals, reproducing lesions similar to those found in women.

All that is lacking is the proof that epithelium actually escapes from or through the tubes into the peritoneal cavity and that this epithelium is alive and capable of growing when transplanted under suitable conditions. In the study of this phase of the subject one is naturally tempted to assume that the dissemination of tissue from normally situated müllerian mucosa might often be similar to that arising from ectopic müllerian mucosa in the ovary, which we realize is due to the menstrual reaction of this mucosa. Many believe that the tissue disseminated in this manner from the lesions of ovarian endometriosis becomes implanted on the peritoneum and therefore it must have been alive in these instances. It should also, therefore, sometimes be alive when derived through the menstrual reaction of müllerian mucosa in other situations.

About ten years ago I began the study of tubal fimbriae with the hope and even the expectation that the primary source of müllerian mucosa on the surface of the ovaries and peritoneum might frequently be found

in tubal fimbriae. My reasons for this were as follows: I was convinced that müllerian tissue in the ovaries was not responsible for all instances of similar tissue on the surface of the peritoneum. Patent tubes played an important rôle in the etiology of müllerian mucosa both on the surface of the ovaries and peritoneum. In many instances the müllerian mucosa in both situations resembled tubal mucosa more closely than uterine. If derived from tubal mucosa that of the fimbriae would be the most accessible. I had encountered one instance of hematosalpinx associated with peritoneal endometriosis.

The fimbriated portions of tubes were carefully observed at operation. Tubes, after their removal, were placed in a dish of normal saline solution in order to float out the fimbriae which were examined then with a hand lens. I looked for any abnormal conditions, particularly for evidence of the origin of müllerian mucosa on the surfaces of the mesosalpinx and ovary from the invasion of these structures by the mucosa of the ovarian fimbriae and also for endometrium-like changes in the mucosa of any of the fimbriae from which epithelium might be disseminated into the pelvic cavity as from similar tissue in the ovary. At the same time tubes were studied for the presence of endometrium-like changes of the mucosa in situations other than their fimbriae, for indications of tubal menstruation, and also for evidence of a back flow of menstrual blood from the uterine cavity through the lumen of the tubes.

The results of the study of tubal fimbriae were not published because they were not as conclusive as I had wished. However that habit was formed of observing tubal fimbriae at operation and of examining microscopically any abnormal ones. The results of this habit I shall present later in this paper.

On the other hand, the evidence indicating that menstrual blood containing bits of uterine mucosa at times escaped through the tubes into the peritoneal cavity was more conclusive. Blood was observed oozing through the abdominal ostia of the tubes of patients operated upon during their menstrual period. The microscopic examination of sections of the tubes of such patients demonstrated not only blood in the lumen of the tubes but, in some instances, fragments of uterine mucosa. In none of these cases was any evidence found of endometrium-like changes in the tubal mucosa. The papers which were published by me from 1923 to 1927 inclusive dealt with further descriptions of the distribution of ectopic müllerian mucosa and a defense[13, 14] of the theory that metastatic müllerian mucosa could arise from the dissemination of müllerian epithelium set free by the menstrual reaction of this mucosa wherever the latter might be situated and especially from that lining the uterine cavity. The importance of patency of the tubes in the etiology of müllerian mucosa on the surface of the ovary and peritoneum was again emphasized in the papers published during this period. Up to that time (1927) 293 cases of peritoneal endometriosis had been encountered. In 284 of them both tubes were apparently patent. Of the remaining nine

cases, a unilateral hematosalpinx was present in three, bilateral hematosalpinx in two. Attention was called to the possible significance of the relative frequency of hematosalpinx in instances where the fimbriated end of one or both tubes was closed.

As a result of these studies I was convinced that pelvic endometriosis at times arose from the implantation of uterine epithelium carried with menstrual blood escaping from the uterine cavity through the patent tubes. However I was disturbed by two facts. One was the possible significance of hematosalpinx when the tubes were occluded and the other was the tubal type of the mucosa in many of the lesions of pelvic endometriosis, some showing an apparent transition from one müllerian type to the other. In order to understand better this apparent transition the variations in epithelium of known uterine origin were carefully studied: that found in the dilated glands of hyperplasias of the endometrium, that covering submucous myomas, and especially that lining the tubules and spaces of a direct or primary endometriosis (uterine adenomyoma of mucosal origin). Similar studies were made of the variations in tubal epithelium found in hydro- and hematosalpinx and in direct or primary endosalpingiosis (adenomyoma of the tube). From these studies I learned, unfortunately, that the type of epithelium present in misplaced müllerian tissue did not prove its source, and that flattened uterine and tubal epithelium might simulate mesothelium.

During the period of study just mentioned an attempt was made to find endometrium-like changes in the tubal mucosa elsewhere than in the fimbriae and also evidence of tubal menstruation. Many tubes removed during various stages of the menstrual cycle were studied and in not a single instance at that time was uterine mucosa found in the portion of a patent tube distal to the uterus. (Since than I have.) Nor was I able to detect any evidence of a typical menstrual reaction in the mucosa of any of the patent tubes.

A study of the specimens of hematosalpinx and their associated pelvic endometriosis was more productive. I was convinced that the blood in the lumen of these tubes was of menstrual origin and that the associated pelvic endometriosis was probably due to the escape of this blood into the pelvic cavity. In 1922[6] such a case was reported by me, already referred to in this paper. In 1927 a similar case was described in which a patch of typical "menstruating" endometrium-like mucosa was found in the ampulla of the tube (see Fig. 58 of that paper[13]). In three cases of hematosalpinx in which there was not only an associated peritoneal endometriosis, but also a "perforating" hematoma of the ovary, the structure of the epithelial lining of the ovarian hematomas and that of the hematosalpinx was the same.

In 1924 Schwarz and Crossen[15] published the results of their study of "endometrial tissue in the ovary." They described an instance of hematosalpinx with endometrial stroma in its mucosa and evidence suggesting tubal menstruation. In Fig. 16

of that article, a photomicrograph of a portion of an ovary with tubal fimbriae adherent to its surface is shown. In the substance of the ovary glands are present which the authors believe may have been derived from the tubal epithelium in contact with the ovary.

In 1925 Schindler[16] reviewed the literature of adenomyosis of the female pelvic organs and of endometrial changes in the tubal mucosa and likewise reported his own observations. In his conclusions he states that endometrial changes in the tubal mucosa may cause tubal pregnancy and by its participation in menstruation hematosalpinx and possibly misplaced epithelial growths in the abdominal cavity by implantation may result.

Robert Meyer,[17] in 1927, reported three cases with endometrium-like changes in the tubal mucosa. He believes that this condition is rare and of little importance. The same year Lahm[18] discussed tubal menstruation due to endometrial changes in the mucosa and reported one case.

From a review of the literature and my own studies I concluded that mucosa of uterine type in patent tubes is of infrequent occurrence except that found in the intramural portion of the tube from the direct extension of the mucosa lining the uterus. On the other hand, as indicated by the study of hematosalpinx and its associated pelvic endometriosis there is strong circumstantial evidence that tubal menstruation is one cause of pelvic endometriosis.

In 1926 I became greatly interested in the lesions resulting from the healing of salpingectomy stumps as a possible means of obtaining a clue to the etiology of peritoneal endometriosis from tubal mucosa. In salpingectomy operations the surgeon unintentionally cultivates tubal mucosa much in the same way as Jacobsen[19] and others have transplanted successfully müllerian mucosa in the lower animals. The results of the study of the first series of these cases was published[11] in 1928. It was found that frequently "sprouts" grew out from the traumatized mucosa of the tubal stump and invaded the tissue of the stump and any organ or structure adherent to it. The misplaced tubal mucosa arising from this source in some instances retained its original structure, but in others it assumed both the structure and function of the uterine mucosa, including its reaction to menstruation and pregnancy (one case). They presented the histologic picture of the müllerian mucosa found in peritoneal endometriosis of nonoperative origin and of endometrial cysts of the ovary. In that paper three cases of the latter were reported which were shown to have arisen from the invasion of the ovary by tubal mucosa from the adherent stump. (Since then two additional cases of this kind have been encountered.)

In a few of the instances in which "sprouts" were not present, "seedlings" were found in or about the operative wound of the tubal stump which I assumed, in some instances, might have grown from müllerian epithelium transplanted by the surgeon at the first operation. In discussing the bearing of these studies on the etiology of peritoneal endometriosis, including that of endometrium-like tissue on the ovaries and of ovarian hematomas lined by similar tissue, I stated that "many of the

endometrium-like lesions of peritoneal endometriosis could be of tubal and not of uterine origin." "If tubal epithelium transplanted during salpingectomy grows, it should also grow if transplanted during other operations than salpingectomy and by other means than operation." I suggested that tubal epithelium might be transplanted during operations from the handling of tubal fimbriae and that some of the instances of postoperative endometriosis in laparotomy scars after cesarean section might be of tubal and not of uterine origin. I was greatly impressed with the frequency with which the endosalpingiosis of operative origin assumed the structure of the uterine mucosa; much more often, in my experience, than endosalpingiosis of nonoperative origin. While I fully realized that it was not safe to assume the source of misplaced müllerian mucosa from its structure, I was inclined to believe that tubal mucosa played a more important rôle in the etiology of pelvic endometriosis than I had previously thought. Further studies[12] in the healing of salpingectomy wounds confirmed the observations made in the first series and prompted me to study tubal fimbriae more intensely. In 1931 Everett[20] published the results of his study of the type of epithelium present in ectopic müllerian mucosa. I can confirm his observations as to the variation in type of müllerian mucosa found in the lesions of "endometriosis"; that many are of tubal type and that frequently both tubal and uterine mucosa are present in the same specimen, suggesting a transition from one type to the other. This phase of the subject was presented by me[16] in 1922, but not as thoroughly as by Everett. As a result of his studies he believed that pelvic endometriosis is of tubal origin by implantation but did not suggest the mechanism of this phenomenon.

It has been shown that bits of uterine mucosa at times are disseminated through the tubes into the pelvic cavity during menstruation and that sometimes they may be viable. I believe the latter because misplaced müllerian mucosa arises in situations easily soiled by menstrual blood from this source in patients without demonstrable ovarian endometriosis. This belief is strengthened by the evidence that bits of müllerian mucosa disseminated, by menstruation, from müllerian mucosa in the ovary can become implanted on the peritoneum.

The evident relation between hematosalpinx and pelvic endometriosis suggests that the latter might have been derived from the implantation of bits of tubal mucosa disseminated by menstruation from the tubes before the latter became occluded.

As is about to be presented, primary fimbrial endometriosis is a source of endometriosis in other situations both by its invasive faculty and also by the menstrual dissemination of its tissue into the peritoneal cavity.

It is more than a coincidence that the spread of müllerian mucosa from all of the above-mentioned sources should apparently arise from the menstrual dissemination of this tissue.

THE PARTICIPATION OF TUBAL FIMBRIAE IN THE LIFE HISTORY OF PELVIC ENDOMETRIOSIS

Should tubal fimbriae take part in the etiology of pelvic endometriosis, the latter must arise either from the direct extension of activated and possibly differentiated fimbrial mucosa over the surface or into the tissues of adjacent structures or from the dissemination of some substance into the pelvic cavity capable of causing patches of müllerian mucosa to appear on the surfaces of the ovaries and peritoneum.

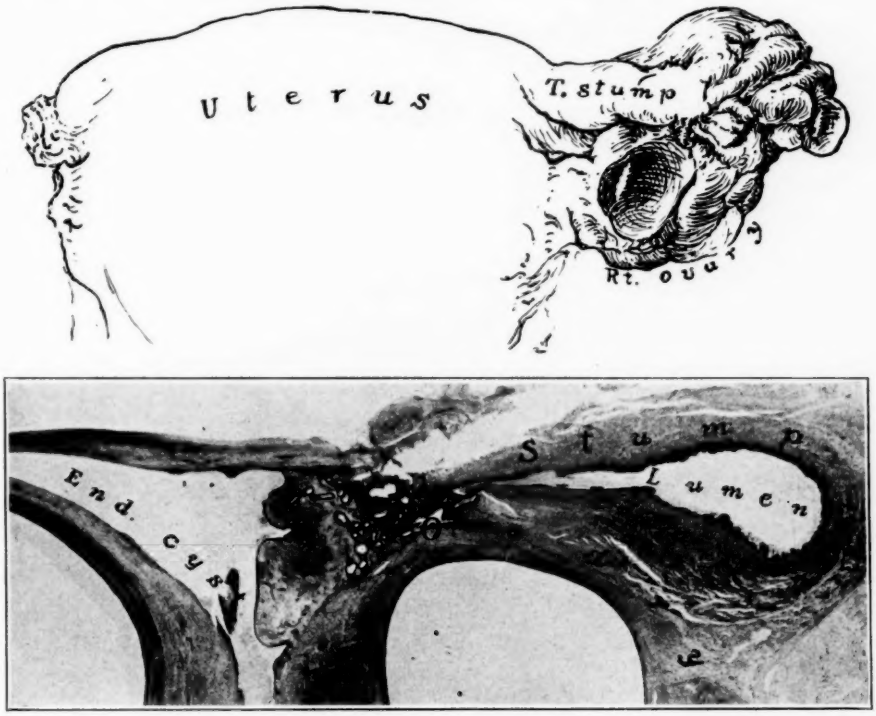

Fig. 1.—A sketch and photomicrograph of an endometrial cyst of the right ovary arising from the invasion of the ovary by the activated mucosa of a tubal stump (see Case 2 of former paper[11]). A previous conservative operation had been done, three years before, for bilateral salpingitis. The sketch shows the tubal stump adherent to and partially embedded in the ovary. Serial cross sections were made of the stump and adherent ovary. The photomicrograph (×10) shows that the lining of the cyst is continuous with the mucosa of the stump. The stump is lined by typical tubal mucosa but that of the cyst resembles endometrium. This case is one of five encountered, in which an endometrial cyst of the ovary arose from the invasion of the ovary by the activated mucosa of a tubal stump. Many instances[11, 12] were found in which endometriosis developed, in like manner, in other structures which were adherent to a tubal stump. Since the general laws governing the healing of tubal wounds are the same, we would expect that similar conditions might arise in the repair of nonoperative injuries of the tubal fimbriae should such injuries occur.

The rim of the abdominal ostium of the tube is covered by irregular processes, the fimbriae, which vary greatly in shape, size and number. The majority of these consist of a continuation of the mucosa of the tube, often in folds, beyond its ostium. In addition, finger-like projections of the tubal wall are sometimes present—the mural fimbriae—some of which are centrally situated and others are arranged about the periphery

of the mucosal fimbriae somewhat like the sepals of a flower. The extension of the tubal mucosa along the free margin of the mesosalpinx, towards the ovary is known as the ovarian fimbria. These may or may not reach that organ (see Fig. 2).

The line of demarcation between the epithelium of the mucosal fimbriae and the mesothelium of the serosa of the tubal wall follows, in a general way, the bases of the fimbriae but in some instances the tubal epithelium extends beyond this point over the surface of the tube, mesosalpinx and ovary. The central mural fimbriae are entirely covered by tubal epithelium. The palmar surfaces of the peripheral mural fimbriae are covered by tubal epithelium but the dorsal surfaces may be entirely or partly covered by mesothelium, the transition between the two often occurring at the tips of the fimbriae. In all specimens which I have ex-

Fig. 2.—Photomicrograph (×5) of a longitudinal section of the fimbriated end of the tube, the mesosalpinx and a small portion of the ovary. The extension of the mucosa of the tube beyond its abdominal ostium over the free margin of the mesosalpinx to the ovary, thus forming an ovarian fimbria, is well shown. The majority of the fimbriae, in this section, are of the mucosal type, similar to the mucosa of the ampulla of the tube. In a few situations finger-like projections of the underlying tissue are present, thus forming mural or stromal fimbriae. At the mucoserosal junction of mural fimbria "*a*" the tubal epithelium ends abruptly (see Fig. 3). A similar termination of the tubal mucosa of the ovarian fimbria occurs at the junction of its epithelium with the surface epithelium of the ovary. A cyst-like space lined by epithelium is present at "*c*" and probably arose from an inclusion of tubal epithelium.

amined, the termination of the epithelial covering of the fimbriae, at its junction with the mesothelium of the serosa of the tube, occurred abruptly, as described by Frank.[21] A similar form of transition is found between the epithelium of ovarian fimbriae, which extend to the ovary, and the germinal epithelium of the latter. This mucoserosal junction apparently constitutes a weak place in the protective covering of the tube and ovary, an area easily stimulated or traumatized and therefore frequently being repaired (see Figs. 3, 4, and 5). This feature may have a bearing on the relative frequency of the development of endometriosis in this situation as will be discussed later.

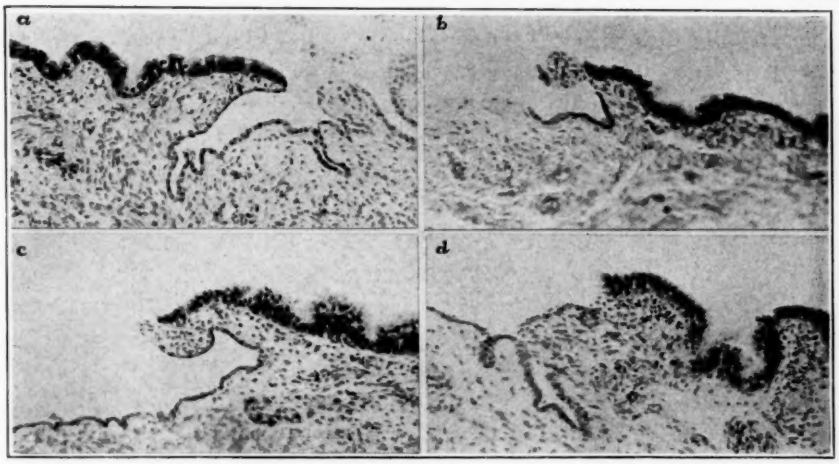

Fig. 3.—Four photomicrographs (×90) showing the "normal" termination of the epithelium of the fimbrial mucosa at its junction with the mesothelium of the serosa from four different patients. This occurs abruptly, often with a gap between the epithelial covering of the fimbriae and the mesothelial covering of the tube. It constitutes a vulnerable and unstable area apparently easily traumatized and therefore frequently undergoing repair. Photomicrograph *"a"* shows a common type of mucoserosal union with a very slight break between the tubal epithelium and serosal mesothelium. In *"b"* there exists at the mucoserosal junction a definite gap through which granulation tissue is protruding and both epithelial and mesothelial cells are being extruded. In *"c"* an extensive gap, without epithelial or mesothelial covering, is present and possibly represents a partially healed stage of the condition shown in Fig. 2. In *"d"* a little different type of mucoserosal junction is shown with a definite break between the epithelium and mesothelium, representing possibly an attempted repair of an injury. Operative trauma of the tubal mucosa in tubal stumps is frequently followed by an activation and differentiation of this mucosa causing *"endometriosis."* Primary fimbrial endometriosis apparently occurs most frequently in the terminal portion of the tubal mucosa at the mucoserosal junction where trauma and repair often take place.

Fig. 4.—Photomicrograph (×60) is of the mucoserosal junction of an apparently normal tube. The mucosa at the base of the fimbriae ends abruptly at *"a"* with a slight break between the epithelium and mesothelium. Epithelial inclusions *"Ep"* are present, thus suggesting a repair of a former injury, but there is no evidence of a differentiation into mucosa of uterine type.

My interest in the fimbriated end of the tube during the last ten years, has resulted in my encountering endometriosis on the serosa of the distal end of the tube in several instances. This was usually of the foreign body type and similar to that frequently found on other pelvic structures including portions of the intestinal tract. During this time I col-

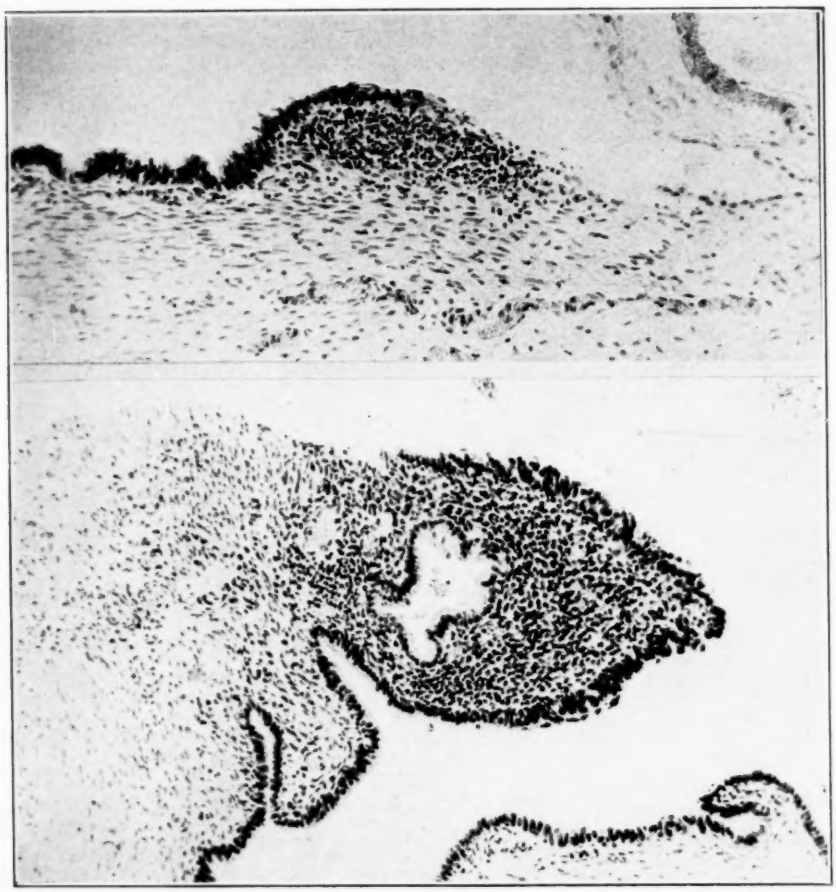

Fig. 5.—Two photomicrographs (×130) of the mucoserosal junction of fimbriae of a normal appearing tube. The patient had had a previous attack of pelvic peritonitis of probable tubal origin. The photomicrographs are from opposite sides of the same longitudinal section of the fimbriated end of the tube. Note the cellular infiltration of the tissue beneath the terminal portion of the epithelium of the tubal fimbriae and the hyperplasia of this epithelium, even suggesting that some of the epithelium could easily become detached and escape into the pelvic cavity. These reactions were found only in this situation. It suggests that this portion of the tubal fimbriae is more vulnerable than the rest of the fimbriae and therefore more likely to become activated and possibly undergo differentiation if given the proper stimulus. The gland-like space in the lower photomicrograph may be either an inclusion of the tubal epithelium or a cross section of a mucosal pocket or depression.

lected fourteen cases of primary fimbrial endometriosis which had developed from a differentiation of the tubal epithelium of the fimbriae.

Had I studied fimbrial endometriosis from the beginning, with my present knowledge of the subject, I would have found many more instances of this condition. In the four weeks prior to the writing of this

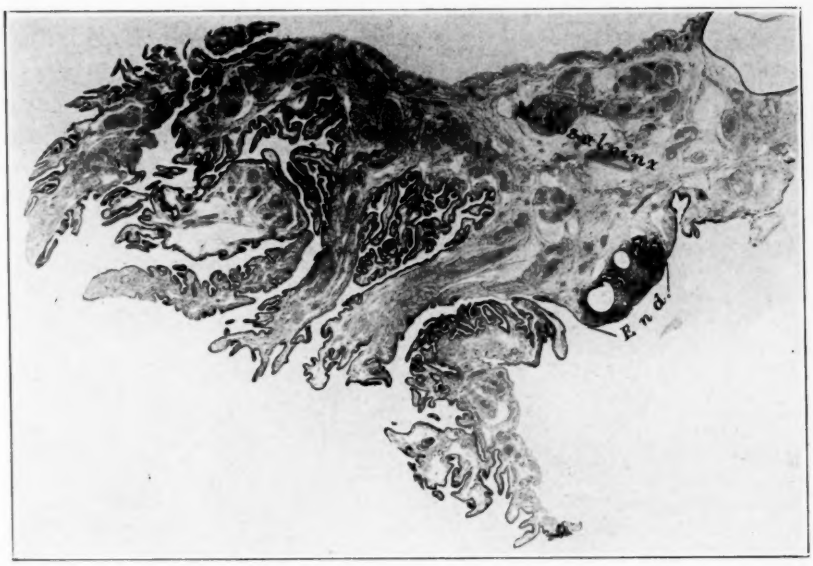

Fig. 6.—Photomicrograph (×8) of an oblique section of the fimbriae of the right tube and a portion of the mesosalpinx showing a primary fimbrial endometriosis *"End."* This has developed in tubal mucosa which had spread from the base of the fimbriae over the surface of the mesosalpinx (see Figs. 7 and 36). Note the preponderance of mural fimbriae.

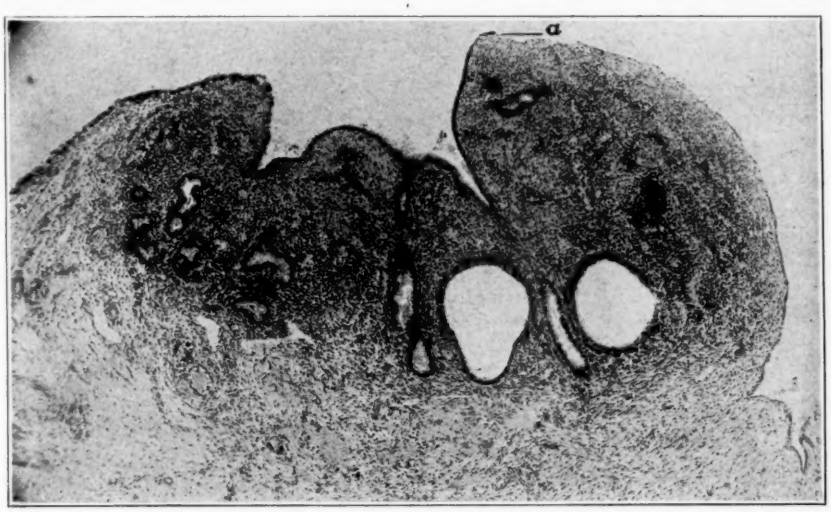

Fig. 7.—Photomicrograph (×50) of the primary fimbrial endometriosis shown in Fig. 6 but taken at a different level of the same block. The endometriosis has developed in the terminal portion of the tubal mucosa near the mucoserosal junction. The patch of differentiated müllerian mucosa is covered by tubal epithelium up to the place indicated by *"a"*: beyond this point, it is covered by mesothelium. The activated tubal epithelium has invaded the underlying tissues of the mesosalpinx forming glands. The tissue about these glands resembles endometrial stroma into which hemorrhage has occurred, thus suggesting a menstrual reaction. At no place was there any evidence of the origin of glands from the mesothelium.

paper I encountered four instances of primary fimbrial endometriosis the data from which have not been completely studied and are therefore not included in this series.

The following cases have been selected which, with the illustrations and their accompanying legends, should portray the conditions I wish to present.

CASE 1.—Primary fimbrial endometriosis of the right tube associated with endometriosis of the lateral surface of the right ovary, and the peritoneum of the posterior culdesac. The patient, aged thirty-seven, was operated upon January 17, 1922, for a large uterine myoma. On account of irregular uterine bleeding, the exact date of the last menstrual period could not be determined. The appendix, both tubes and

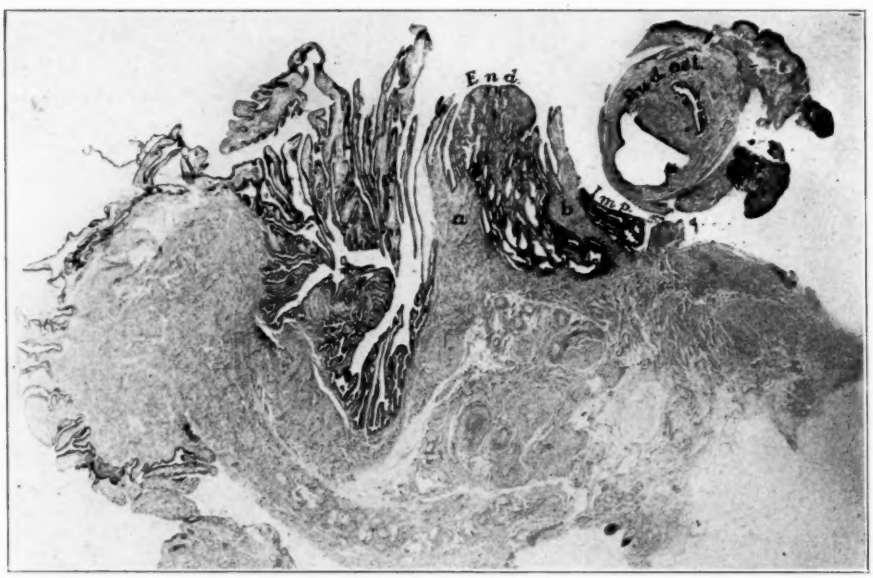

Fig. 8.—Photomicrograph (×8) of a longitudinal section of the fimbriated end of the tube lateral to its lumen, and a portion of the mesosalpinx (Case 2, see Fig. 37). Primary fimbrial endometriosis *"End."* has developed between two mural fimbriae, *"a"* and *"b."* Secondary fimbrial endometriosis *"Imp."* is present on the serosa of the dorsal surface of mural fimbria *"b"* near its base (see Fig. 9). A cross section of what might be a rudimentary tubal ostium *"Rud. ost."* appears at the right (see also Fig. 37) with implantation-like endometriosis on its serosal surface (torn and misplaced in restaining the section).

ovaries and uterus were removed. Both tubes were apparently patent. The fimbrial endometriosis arose from the activation of tubal epithelium at the mucoserosal junction of tubal mucosa which had spread over the surface of the mesosalpinx from the base of the fimbriae (see Figs. 6, 7, and 36).

CASE 2.—Primary fimbrial endometriosis of the right tube associated with a large hemorrhagic cyst of that ovary and endometriosis of the lateral surface of the left ovary, and the peritoneum of the posterior culdesac. The patient, aged thirty-eight, was operated upon November 22, 1923, for a large hemorrhagic cyst of the right ovary (about fifteen centimeters in its greatest diameter). The appendix, both tubes and ovaries and uterus were removed. Both tubes were apparently patent. The fimbrial endometriosis arose from a differentiation of the tubal mucosa just proximal to its mucoserosal junction (see Figs. 8, 9, and 37).

CASE 3.—Primary fimbrial endometriosis of the left tube associated with endometriosis of the lateral surface of the left ovary and the peritoneum of the posterior culdesac. The patient, aged forty-six, was operated upon February 19, 1928, for a large uterine myoma. She expected to menstruate within a day or two of the operation, but began to flow that morning. The appendix, left tube and ovary and uterus were removed. Both tubes were apparently patent. The fimbrial endometriosis arose from a differentiation of the tubal mucosa at or near the mucoserosal junction and by direct extension had invaded the wall of the tube, giving rise to an "endometrial" cavity, the mucosal lining of which showed a characteristic menstrual reaction with evidence that its contents might readily escape into the peritoneal cavity (see Figs. 10, 11, 12 and 38).

CASE 4.—Multiple primary fimbrial endometrioses of the right tube with invasion of the tubal wall but without ovarian or peritoneal endometriosis. The patient, aged

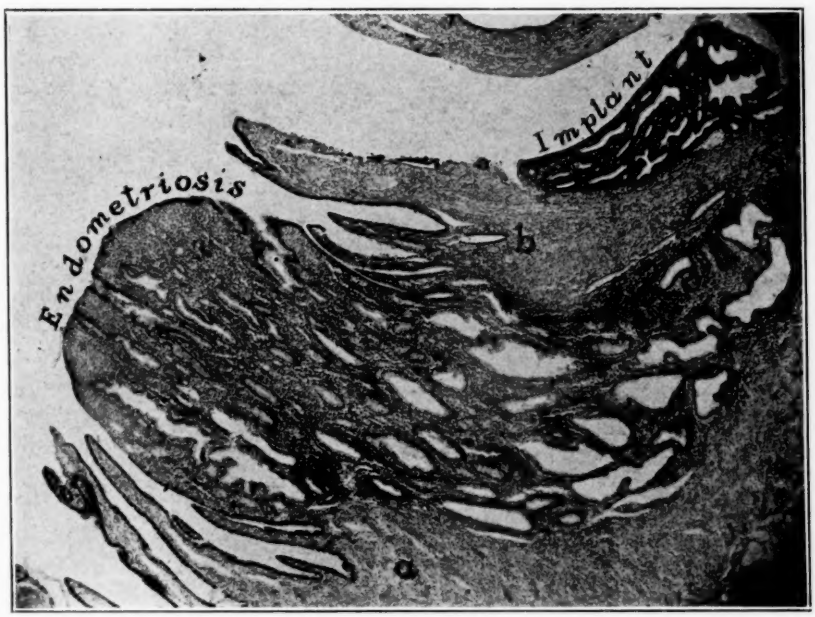

Fig. 9.—Photomicrograph (×25) showing better the origin of the primary fimbrial endometriosis *"End."* and the situation of the secondary endometriosis *"Imp."* of Fig. 8. The surface epithelium of the primary endometriosis is continuous with that of the normal fimbriae. The epithelium forming the glands is continuous with the surface epithelium. The endometriosis evidently arose from an activation and differentiation of this epithelium and the tissues invaded by it. The palmar surface of mural fimbriae *"b"* is covered by epithelium but its dorsal surface by mesothelium, the transition between the two occurring at the tip of the fimbria. The secondary endometriosis on the serosa of the base of this fimbria is of an implantation type, without an epithelial covering and encapsulated, compare with the primary endometriosis above it. The stroma surrounding the glands of this endometriosis resembles that of the endometrium.

forty-three, was operated upon September 23, 1931, twelve hours after the onset of her menstrual period, for the result of the injuries of childbirth and myofibrosis uteri. The uterus, right tube and ovary were removed and the pelvic floor repaired. Both tubes were apparently patent. Multiple hemorrhagic fimbriae of the right tube were present which arose from a differentiation of the tubal mucosa apparently at or near their mucoserosal junction. Endometriosis was present in the wall of the tube and apparently arose from the direct extension of the fimbrial endometriosis (see Figs. 13, 14, 15, and 39).

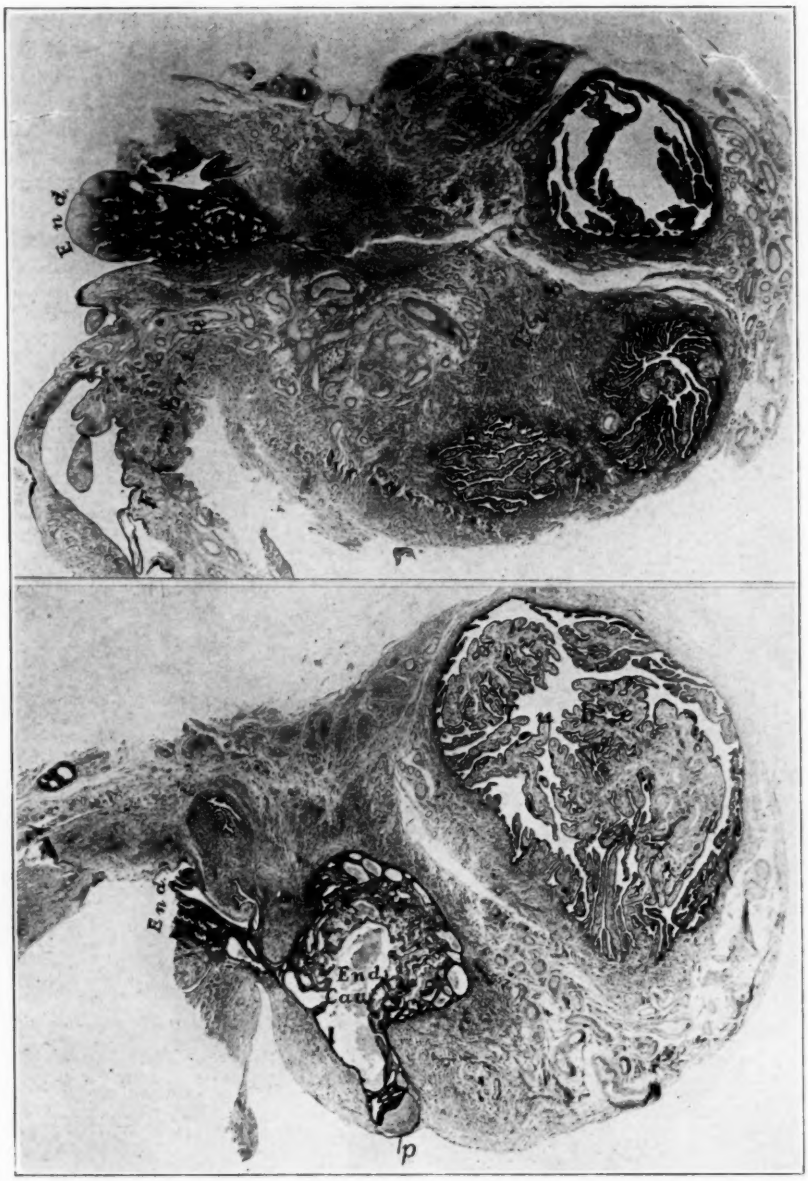

Fig. 10.—Two photomicrographs (×8) of cross sections of the distal end of the tube at the base of the fimbriae showing primary fimbrial endometriosis with invasion of the mesosalpinx by this tissue (Case 3, see also Fig. 38). The first shows the relation of the differentiated fimbriae, *"End."* to the normal fimbriae below it. From its situation it must have arisen in the terminal portion of the fimbrial mucosa although the mucoserosal junction was not definitely determined. The second demonstrates the origin of an endometrial cavity, *"End. Cav.,"* in the mesosalpinx from the invasion of this structure by the differentiated tissue of the fimbrial endometriosis. The section is incomplete and shows only the base of the differentiated fimbria *"End."* The patient began to menstruate the morning of the operation. Blood was present in the stroma of the fimbria and also in the endometrial cavity (see Fig. 11). It is conceivable that müllerian tissue with menstrual blood might escape into the pelvis through a potential perforation, at *"p,"* and become implanted on the peritoneum, as such tissue becomes implanted when it is disseminated from similar cavities (cysts) of the ovary.

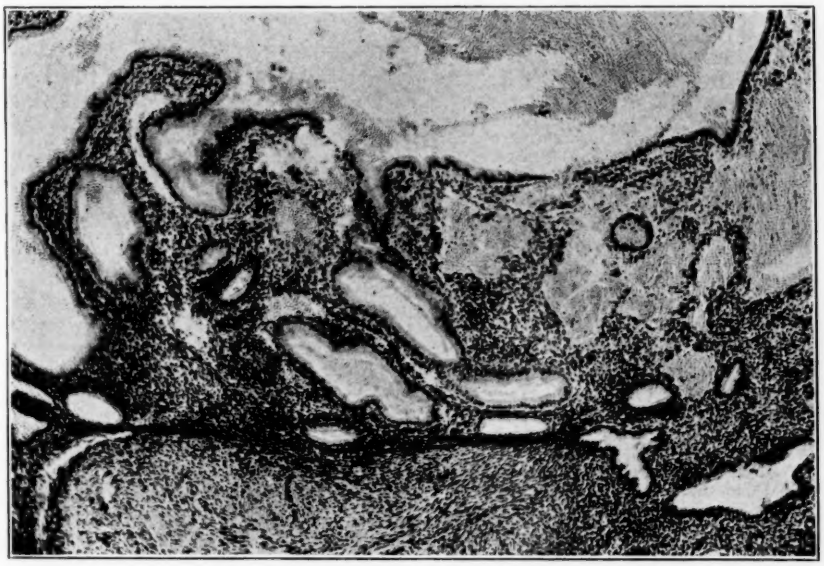

Fig. 11.—Photomicrograph (×60) of a portion of the wall and mucosal lining of the endometrial cavity shown in the preceding section. A characteristic reaction to menstruation is present, the lumen of the cavity containing blood and cast-off epithelium which might escape through the potential perforation of the wall of this cavity indicated by "*p*" of Fig. 10.

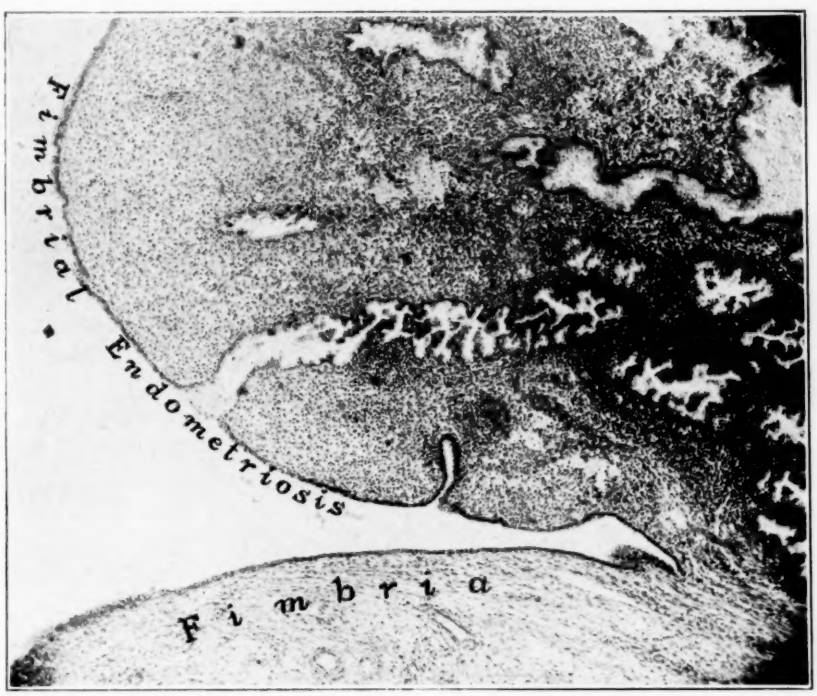

Fig. 12.—Photomicrograph (×60) of a portion of the differentiated fimbria *"End."* of the upper photomicrograph of Fig. 10. The epithelial covering of the fimbrial endometriosis is continuous with that of the normal fimbria below it. The glands arose from surface epithelium of tubal type; other portions of this fimbria were covered by epithelium of an indefinite type. The mucoserosal junction was not determined.

CASE 5.—Primary fimbrial endometriosis of the left tube, causing a tuboovarian endometrial cyst, associated with peritoneal endometriosis in the posterior culdesac and an intracervical carcinoma. The patient, aged thirty-seven, was operated upon November 9, 1931. The preoperative diagnosis was extensive peritoneal endometriosis. The last menstrual date was not determined on account of irregular uterine bleeding. On exposing the pelvic contents, the right tube and ovary appeared normal. The left ovary was enlarged and adherent by its lateral surface to the posterior layer of the left broad ligament and to the side of the pelvis. On freeing the ovary, old

Fig. 13.—Photomicrograph (×7) of a longitudinal section of the fimbriated end of a tube through the center of its lumen (Case 4, see also Fig. 39). Two mural fimbriae "*a*" and "*b*" appear in oblique section, each the seat of a primary endometriosis. Endometriosis is also present in the wall of the tube. For the relation between the endometriosis of the fimbriae and that of the tubal wall (see Fig. 14) and for the origin of the fimbrial endometriosis (see Fig. 15).

blood escaped, and it was noted that the fimbriated end of the patent tube protruded into the cavity of an ovarian cyst. The wall of the cyst was torn at this place, but fortunately a portion of the attachment of the tube to the cyst was not disturbed (Fig. 16).

The lower portion of the posterior culdesac was obliterated by an extensive endometriosis. The appendix, both tubes, ovaries and entire uterus were removed. The bottom of the culdesac was curetted and a large amount of müllerian mucosa was removed (see Fig. 19). On incising the uterus, after its removal, an unsuspected

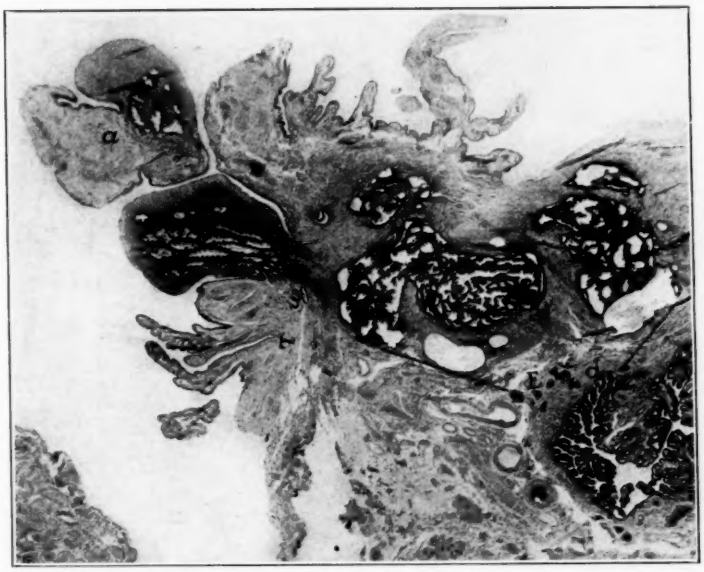

Fig. 14.—Photomicrograph (×7) of a longitudinal section of the fimbriated end of the tube shown in Fig. 13, from the same block, but near the periphery of the tube. Serial sections were not made and therefore the relation between the endometriosis of the fimbriae shown in this and in Fig. 13 was not determined. The endometriosis of the tubal wall is the same as that shown in Fig. 13. Note the proximity of the endometriosis of the tubal wall, "*End.*," to that of the base of fimbria "*b*" suggesting that the endometriosis of the tubal wall arose, by direct extension, from the fimbrial endometriosis as in Fig. 10. I was unable to definitely establish this connection. If present it was lost in trimming the block. The section shown in this illustration was the first complete section from the block.

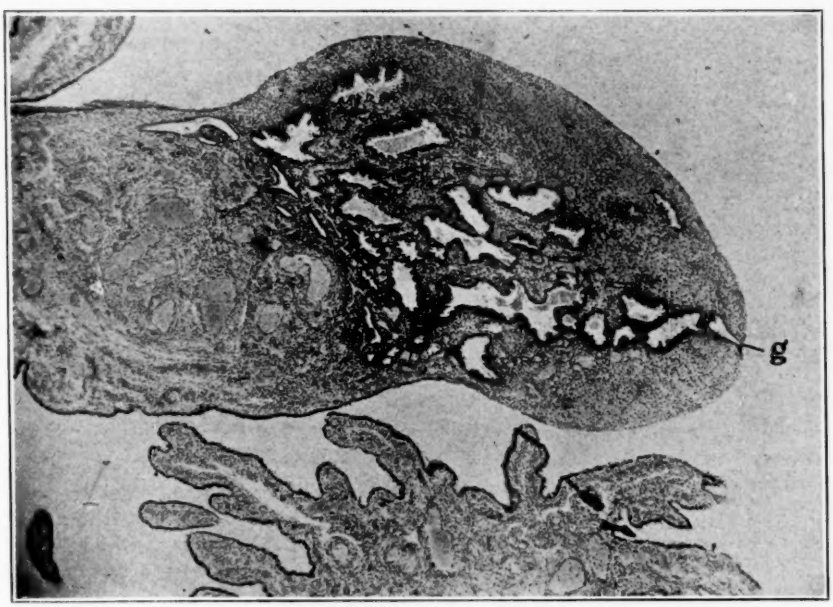

Fig. 15.—Photomicrograph (×25) of a portion of mural fimbria "*a*" shown in Fig. 13. The dorsal (upper) surface of the fimbria is covered by mesothelium except at the extreme right where both mesothelium and epithelium are lacking. The palmar surface (below) is covered by tubal epithelium, patchy towards the right. The tubule or gland "*g*" has arisen from a patch of tubal epithelium on the surface of the fimbria and from its situation, must represent the terminal portion of the fimbrial mucosa at or near the mucoserosal junction. The endometriosis of the fimbria evidently arose from the activation and differentiation of the tubal epithelium covering it. There is an extravasation of blood in the stroma of the fimbria, probably due to a menstrual reaction. The operation occurred twelve hours after the onset of menstruation.

early intracervical carcinoma was found. Sections were made through the fimbriated end of the tube and the wall of the ovarian cyst (Fig. 16). The müllerian mucosa lining the cyst was continuous with that of the tubal fimbriae (see Figs. 17 and 18).

CASE 6.—Primary fimbrial endometriosis of the left tube, causing a tuboovarian endometrial cyst associated with endometriosis of the mucosa of the left tube, an endometrial cyst of the opposite ovary, extensive peritoneal endometriosis especially in the posterior culdesac with extension through to the posterior vaginal vault, and myoma uteri. The patient, aged twenty-nine, was operated upon November 27, 1926, two weeks after her last menstrual period, for bilateral ovarian hematomas. On exposing the pelvic contents, at operation, the pelvic structures were found to be covered with old blood. The endometrial cyst of the right ovary was about 10 cm. in diameter, the tube appeared normal. The endometrial cyst of the left ovary was

Fig. 16.—A sketch of the anterior or lateral view of the left tube and ovary (Case 5). The fimbriated end of the tube opened into the cavity of the cyst thus forming a tuboovarian cyst. This relation was partially disturbed in freeing the adherent ovary at the operation. For the origin of the lining of the endometrial cyst from the differentiated mucosa of the tubal fimbria (see Figs. 17 and 18).

about 6 cm. in diameter. The left tube was patent and opened into the cavity of an endometrial cyst of that ovary, thus forming a tuboovarian cyst. The appendix, uterus and both tubes and ovaries were removed. For further description of the condition found see Figs. 20, 21, 22, 23, and 24.

CASE 7.—Primary fimbrial endometriosis of the left tube associated with endometriosis of the lateral surface of the left ovary, the posterior layer of the left broad ligament and peritoneum of the posterior culdesac. The patient, aged forty-one, was operated upon June 7, 1930, the third day of her menstrual period, usually of seven to eight days' duration, for a large myomatous uterus. On exposing the pelvic contents a small amount of blood was present in the pelvis. The left ovary was fused by its lateral surface with the posterior layer of the left broad ligament. The appendix, left tube and ovary and uterus were removed. Both tubes were apparently

patent. The portion of the posterior layer of the left broad ligament, adherent to the lateral surface of the ovary, was carefully removed with the ovary. The tube, ovary and portion of peritoneum attached to the latter were fixed in formalin and sections were made in a horizontal plane. An endometrial cavity (cyst) had developed between the lateral surface of the left ovary and the portion of the posterior layer of the broad ligament adherent to the ovary. Patches of endometriosis were found on the lateral surface of the ovary and on the surface of the mesosalpinx, ex-

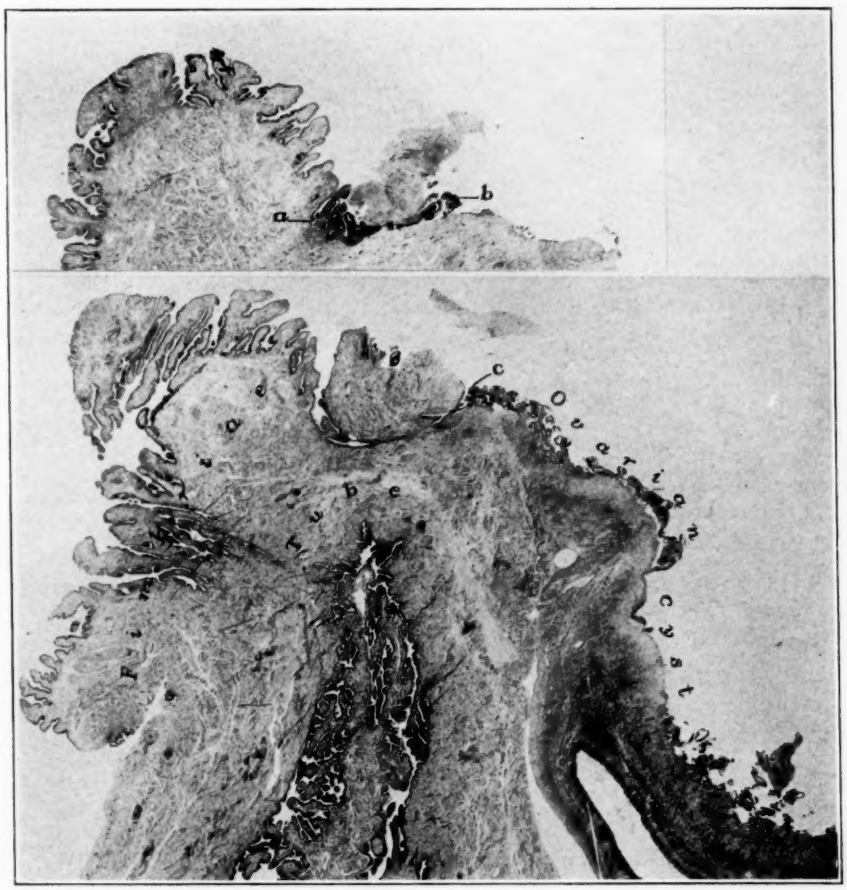

Fig. 17.—Two photomicrographs (×7) of longitudinal sections, at different levels, of the fimbriated end of the tube and a portion of the wall of the ovarian cyst into the cavity of which the fimbriated end of the tube opened (see Fig. 16). At "*a*" of the upper photomicrograph, the differentiation of the terminal portion of the mucosa of the fimbria (probably an ovarian fimbria) into mucosa of endometrial type is well shown (see Fig. 18). By serial sections it was shown that the differentiated mucosa indicated by "*b*," a continuation of "*a*," is also continuous with that of "*c*" of the lower photomicrograph which in turn is continuous with the mucosal lining of the endometrial cyst of the ovary, a portion of the wall of which is fused with the wall of the tube. Therefore the endometrial cyst of the ovary arose from the activated and differentiated mucosa of the tubal fimbria as similar cysts may arise from the activated and differentiated mucosa of a tubal stump (see Fig. 1).

tending up to the base of the ovarian fimbria where the primary endometriosis had arisen from a differentiation of the terminal portion of the tubal mucosa at the mucoserosal junction. A similar differentiation of fimbrial epithelium was present at the base of fimbriae on the opposite side of the tube. This had invaded the mesosalpinx. For a further description of the condition found see Figs. 25, 26, 27, and 28.

CASE 8.—Probable primary fimbrial endometriosis of the right tube associated with an endometrial cyst of the right ovary and peritoneal endometriosis. The patient, aged thirty, was operated upon November 8, 1922, in the interval stage of her menstrual cycle, for an adherent, retroflexed myomatous uterus. On exposing the pelvic contents, old blood was present in the culdesac coming from a partially collapsed endometrial cyst of the right ovary, about three centimeters in its greatest diameter. The appendix, right tube and ovary and uterus were removed. Both tubes were apparently patent. Endometriosis had developed at the mucoserosal junction of the ovarian fimbriae (see Figs. 29 and 40).

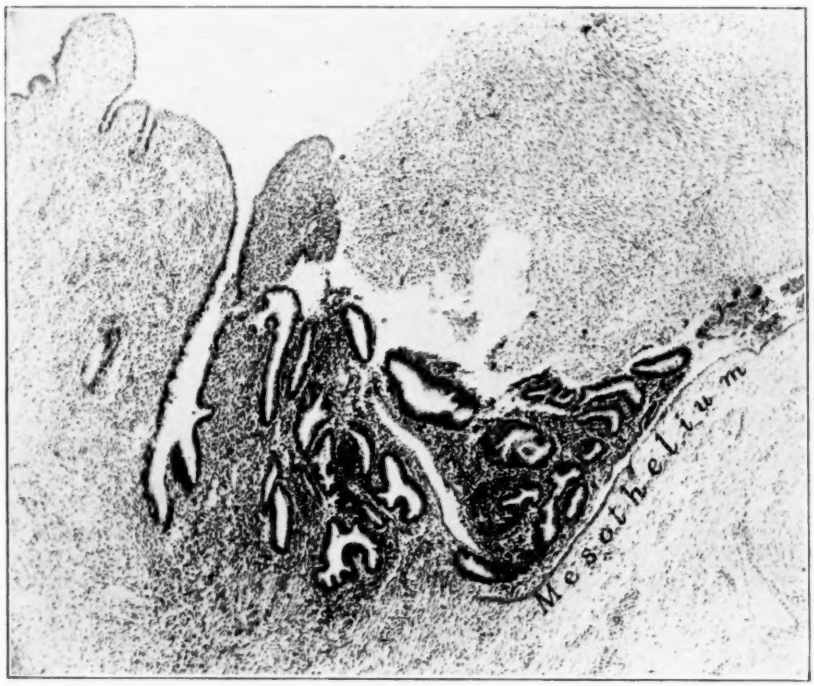

Fig. 18.—Photomicrograph (×60) of the terminal portion of the mucosa of the tubal fimbria shown at "a" of the upper photomicrograph of Fig. 17. The normal tubal fimbriae appear at the left. One can see the gradual transformation of their normal tubal mucosa into mucosa of uterine type: similar to the transition of the epithelium of normal mucosa to cancer. The mesothelium apparently has not taken an active part in the origin of this differentiated mucosa but is being overridden and destroyed by it as by the advancing margin of a new growth.

CASE 9.—Endometriosis of the left tube, of probable implantation origin, associated with extensive endometriosis of the right uterine cornu, endometrial implants on the anterior surface of the uterus about the origin of both round ligaments and on the under surface of the left ovary. The patient, aged thirty-eight, was operated upon January 12, 1925, during the interval stage of her menstrual cycle, for the results of the injuries of childbirth and dysmenorrhea. The appendix, left tube and ovary and uterus were removed, and the pelvic floor repaired. Both tubes were apparently patent. I was unable to determine the origin of the endometriosis of the right uterine cornu, whether from the mucosa of the intramural portion of the tube or from implantations on the peritoneal surface of the cornu. For a comparative study of the endometriosis of the tubal fimbria, the peritoneum of the left uterine cornu and the ovary, see Figs. 30 and 31.

CASE 10.—Multiple small nodules of granulation tissue on the fimbriae of the right tube associated with endometriosis of the lateral surface of the right ovary, posterior surface of the uterus, the peritoneum of the posterior culdesac and the cecum. The patient, aged thirty-one, was operated upon September 26, 1922, the second day of her menstrual period, for an adherent retroflexed uterus. On exposing the pelvic contents, blood was observed escaping through the abdominal ostium of both tubes. The uterus, right tube and ovary and appendix were removed. For the description of the fimbrial lesions of the right tube, see Figs. 33 and 41.

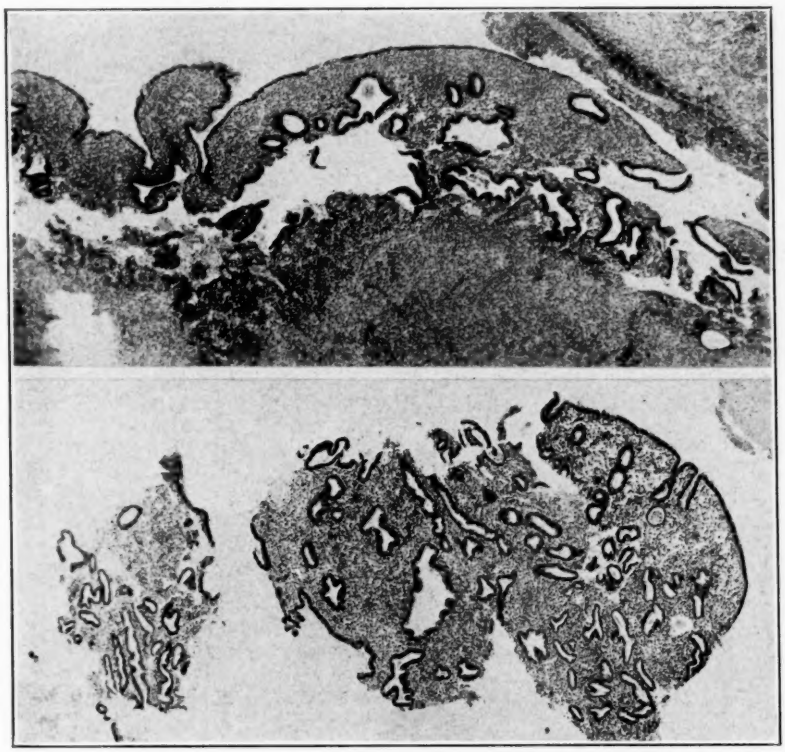

Fig. 19.—Two photomicrographs (×25), the upper one is of the endometrial lining of the ovarian cyst shown in Fig. 17, and the lower is of tissue curetted from the bottom of the posterior culdesac of the same case. The histologic structure of the mucosa in the two sections is the same. We have demonstrated the origin of the müllerian lining of the cyst. How shall we account for that in the culdesac?

CASE 11.—Endometriosis of the serosa of the left tube near the mucoserosal junction of the fimbriae associated with endometriosis in the posterior culdesac. The patient, aged twenty-six, was operated upon November 28, 1928, for conditions resulting from the injuries of childbirth and for uterine bleeding. A curettage of the uterus, amputation of the cervix and repair of the pelvic floor was done first. This was followed by an abdominal section. On exposing the pelvic contents a small amount of blood was found in the posterior culdesac, the left tube was slightly distended with blood which was oozing through its abdominal ostium. The appendix, left tube and ovary were removed and a tubal sterilization on the right side and ventral fixation of the uterus was done. Endometriosis was detected only on serosa of the distal end of the left tube (see Figs. 34 and 35) and in the posterior culdesac. The microscopic examination of sections of the left tube showed the remains of an early tubal pregnancy.

A study of the conditions in the cases just reported (see also the illustrations and their legends), as well as material from other similar cases demonstrates that endometriosis may arise from a differentiation of the mucosa of tubal fimbriae into a structure resembling endometrium. This differentiated and activated mucosa may invade or spread over the surfaces of the wall of the tube and the mesosalpinx. When it arises

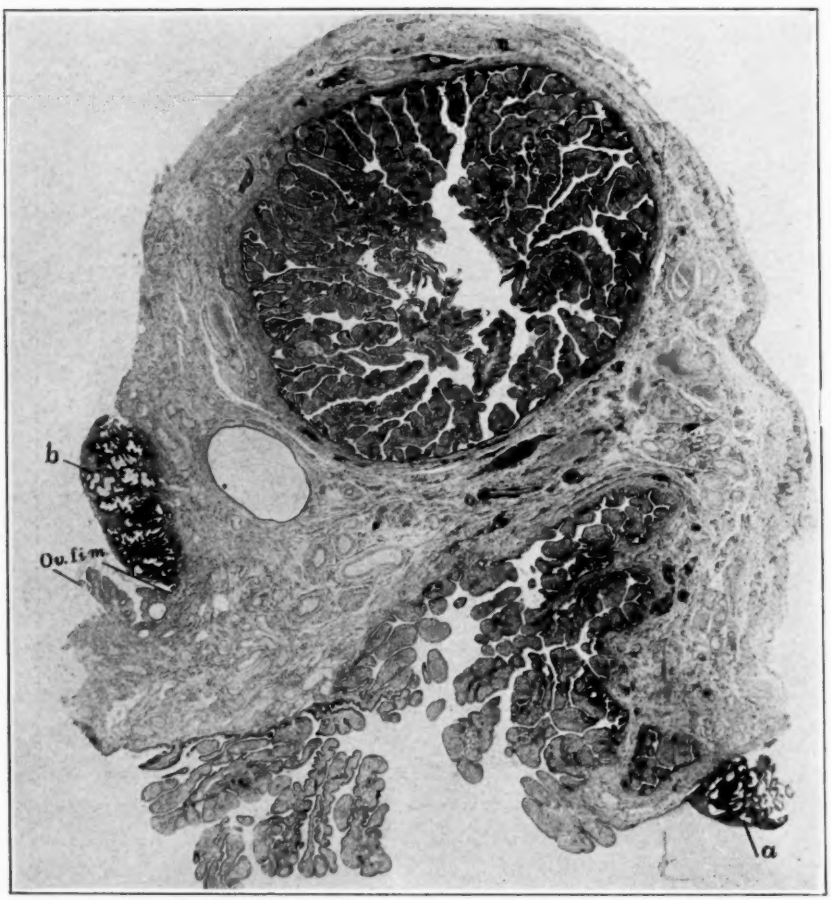

Fig. 20.—Photomicrograph (×7) of a slightly oblique section of the fimbriated end of the tube (Case 6). The ampulla of the tube appears above in cross section. The fimbriated end of the tube opened into the cavity of an endometrial cyst of the ovary as in Fig. 16 of the preceding case. Two patches of fimbrial endometriosis are present, both arising from an activation and differentiation of the terminal portion of the tubal mucosa at the base of fimbriae. For a higher magnification of endometriosis *"a"* (see Fig. 21). Endometriosis *"b"* is situated at the base of an ovarian fimbria *"Ov. fim."* The continuity between the main tubal fimbriae and the ovarian fimbriae is evident in preceding sections from the same block.

in ovarian fimbriae it may likewise involve the ovary sometimes causing endometrial cysts of that organ.

In three of the cases, with an associated ovarian endometrial cyst, the endometrial lining of the cyst was demonstrated to be continuous with the endometriosis arising from the fimbrial mucosa. Two of these are reported in this paper (see Figs. 17 and 22).

In three patients operated upon during their menstrual period a typical menstrual reaction was present in the fimbrial endometriosis (Figs. 10, 13, and 27) and in two of these a similar reaction occurred in the endometriosis associated with and derived from the fimbrial endometriosis (Figs. 11 and 27). Bits of müllerian tissue must escape into the peritoneal cavity from this menstruating mucosa and should have the same potentialities of implantation as those escaping from similar lesions in the ovary.

Primary fimbrial endometriosis, in the cases in which I have been able to determine the exact site of its origin, has developed in the terminal

Fig. 21.—Photomicrograph (×25) of fimbrial endometriosis "*a*" of Fig. 20, showing its origin from the tubal mucosa at the mucoserosal junction. The differentiated mucosa has spread (ridden) over the serosa of the tube as indicated by inclusions of the mesothelium "*m*" beneath it. The distal portion (to the left) of this patch of endometriosis was evidently torn during the operation.

portion of the tubal mucosa of the fimbriae at or near the mucoserosal junction. I believe that it may arise in other portions of the fimbriae because I have encountered two instances, in this series, in which endometriosis had arisen in the mucosa of the ampulla of the tube. One of these is described in this paper in Figs. 22 and 24.

This series of only fourteen cases of primary fimbrial endometriosis is too small in number to be of any statistical value. Nevertheless it suggests that the conditions present in the terminal portion of the mucosa of the fimbriae constitute an important factor in the etiology of the differentiation of tubal mucosa into mucosa of uterine type. It is well known that endosalpingiosis of nonoperative origin occurs most frequently in the intramural portion of the tube where the transition usually takes place from uterine to tubal epithelium, apparently a vulnerable area. There is present at the mucoserosal junction of the fimbriae also a transition from one type of cellular covering to another.

The repair of operative trauma of the mucosa of the tube in tubal

stumps is frequently followed by an activation of this mucosa which may invade not only the stump but also any organ or structure normally continuous with the stump or becoming adherent to it. The misplaced tubal mucosa arising from the outgrowth of the traumatized mucosa of the stump may become differentiated into mucosa of the structure and function of the endometrium (see Fig. 1). I have demonstrated, in the present study, that the extension of the differentiated mucosa of primary fimbrial endometriosis causes endometriosis in adjacent structures, in-

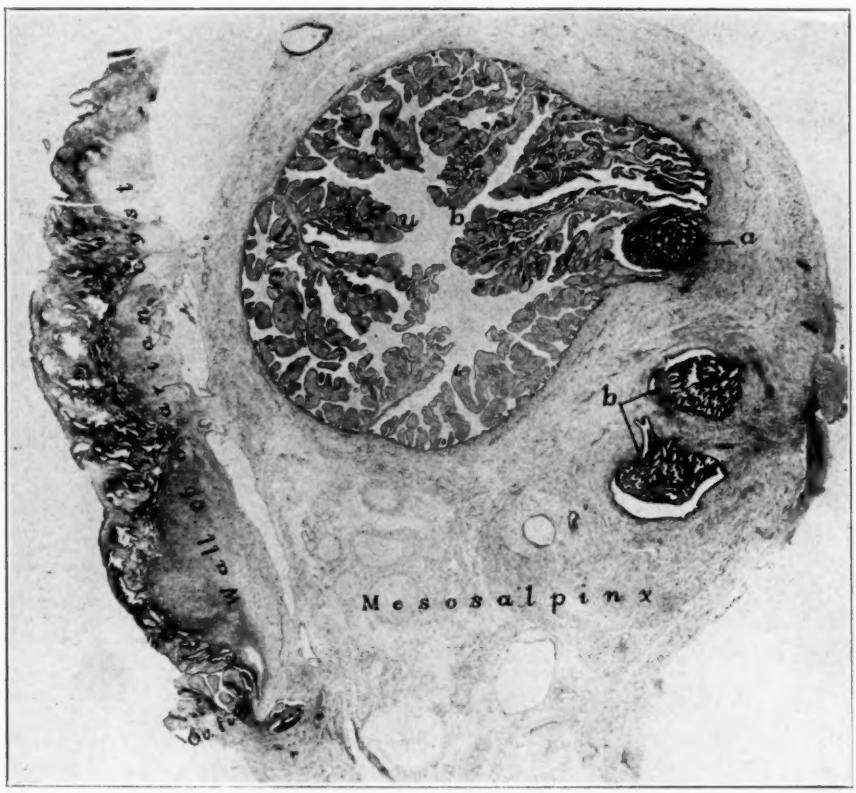

Fig. 22.—Photomicrograph (×7) of a cross section of the ampulla of the tube and a portion of the adherent wall of the endometrial cyst of the ovary into the cavity of which the fimbriated end of the tube emptied. This section is proximal to that of Fig. 20. Ovarian fimbriae "*Ov. fim.*" still appear at this level. The endometrium-like lining of the cyst is continuous with the differentiated mucosa arising in the terminal portion of the tubal mucosa at the mucoserosal junction of the fimbriae as in Fig. 17 of the preceding case. Endometriosis "*a*" is present in the mucosa of the ampulla of the tube, for its origin see Fig. 24. I was unable to determine the source of the endometriosis "*b*" in the wall of the tube, whether from the endometriosis of the tubal mucosa above it or from an implant on the surface of the tube lateral to it.

cluding endometrial cysts of the ovary, similar to those following the repair of tubal stumps. Can a like etiology for the two conditions be demonstrated? The abrupt ending of the tubal mucosa at the mucoserosal junction of the fimbriae often with a gap between the epithelium and mesothelium, may simulate the severed mucosa of a tubal stump. The frequent evidence of minor injuries in this situation and their re-

pair even in normal appearing tubes, as illustrated in Figs. 3, 4, and 5, are indications of the vulnerability of the tissues at this mucoserosal junction. The general laws governing the repair of injuries of the various organs and structures of the body are the same whether caused by

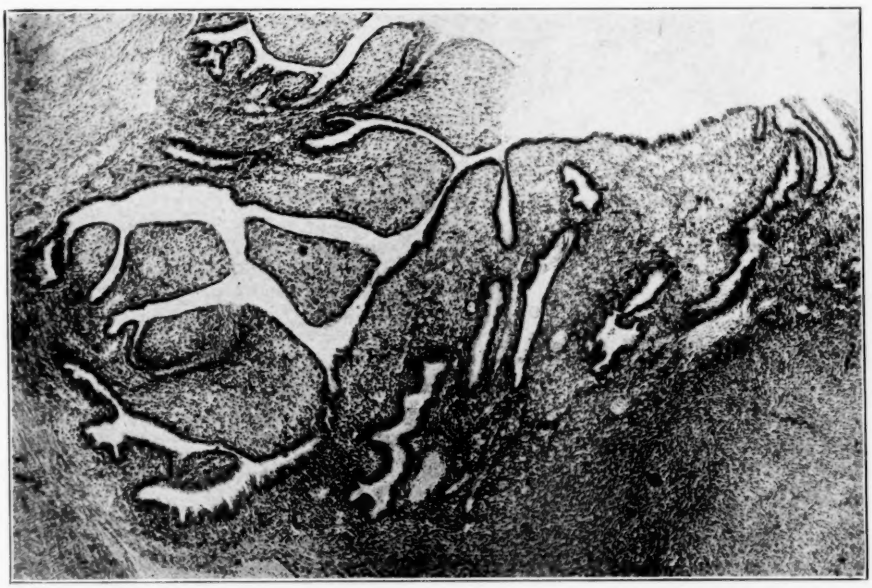

Fig. 23.—Photomicrograph (×60) demonstrating the development (origin) of the lining of the endometrial cyst of the ovary (see Fig. 22) from the mucosa of the fimbriae. The transition (differentiation) of the mucosa of the fimbriae (to the left) into the endometrium-like mucosa of the cyst is well shown.

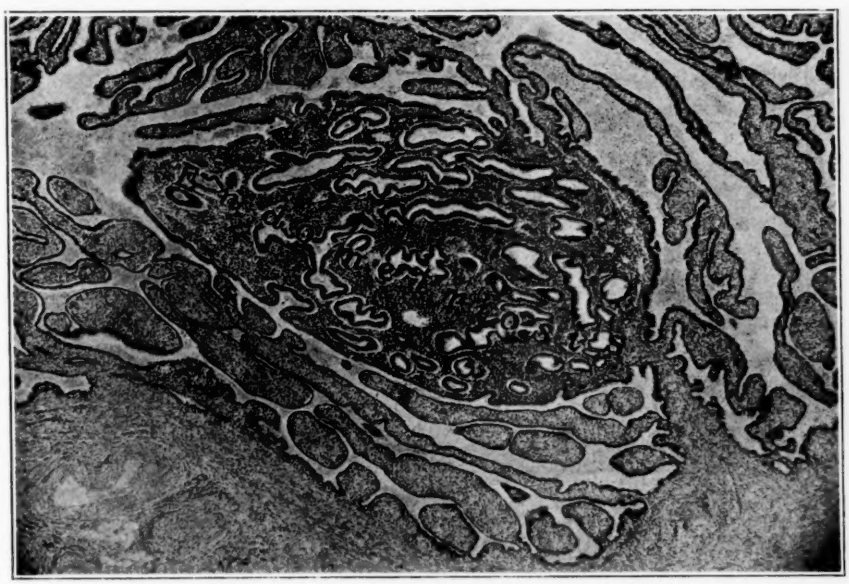

Fig. 24.—Photomicrograph (×25) demonstrating the differentiation of the mucosa of the ampulla of the tube into endometrium-like mucosa. It was shown, by serial sections, that endometriosis "*a*" of Fig. 22 was continuous with this.

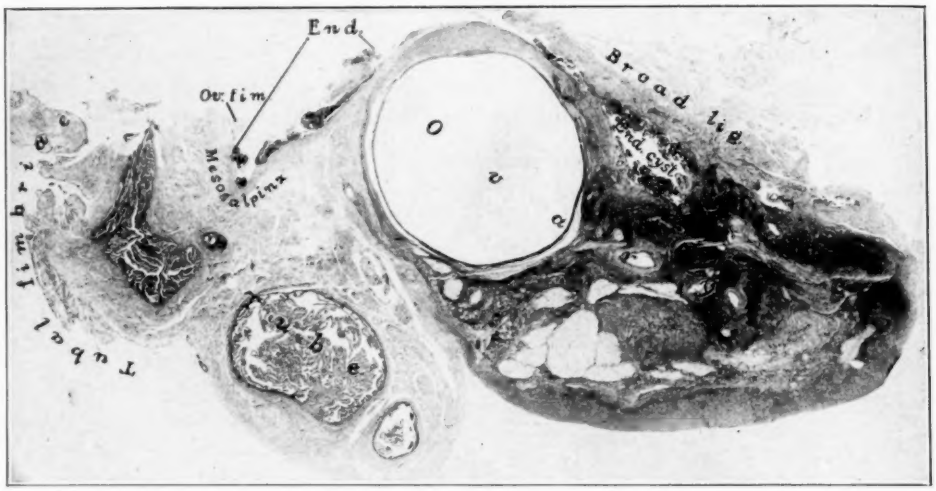

Fig. 25.—Photomicrograph (×3½) of a horizontal section of the distal third of the left tube and mesosalpinx, the entire ovary and the part of the posterior layer of the broad ligament adherent to the ovary (Case 7). An endometrial cavity (cyst) *"End. cyst"* is situated between the lateral surface of the ovary and the adherent broad ligament. The ovarian fimbriae *"Ov. fim.,"* torn at their origin, extend only a short distance over the free margin of the mesosalpinx. From the base of these fimbriae (see also Fig. 26) endometriosis *"End.,"* appearing in patches, has spread over the surface of the mesosalpinx and extends to and even over the surface of the ovary towards the endometrial cyst.

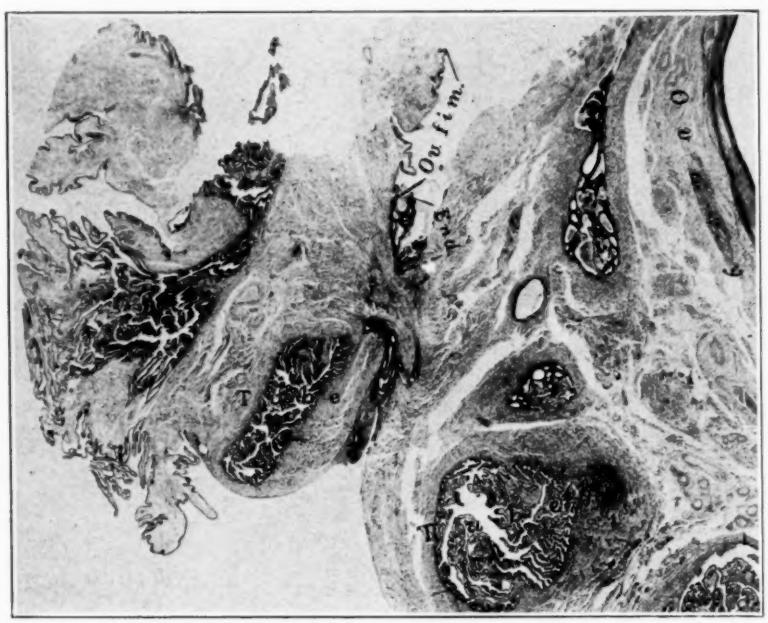

Fig. 26.—Photomicrograph (×8) of a section of the fimbriated end of the tube and part of the ovary shown in the preceding illustration, from the same block and very near the other. Some of the tubal fimbriae, including the proximal ovarian fimbriae were torn in trimming the block, but fortunately the distal portion of the ovarian fimbriae, *"Ov. fim.,"* is shown in this photomicrograph with endometriosis, *"End.,"* arising at their mucoserosal junction (see Fig. 27). Endometriosis is present on the surface of the tube, the ovary and in the mesosalpinx. For the origin of the endometriosis in these situations see Fig. 28.

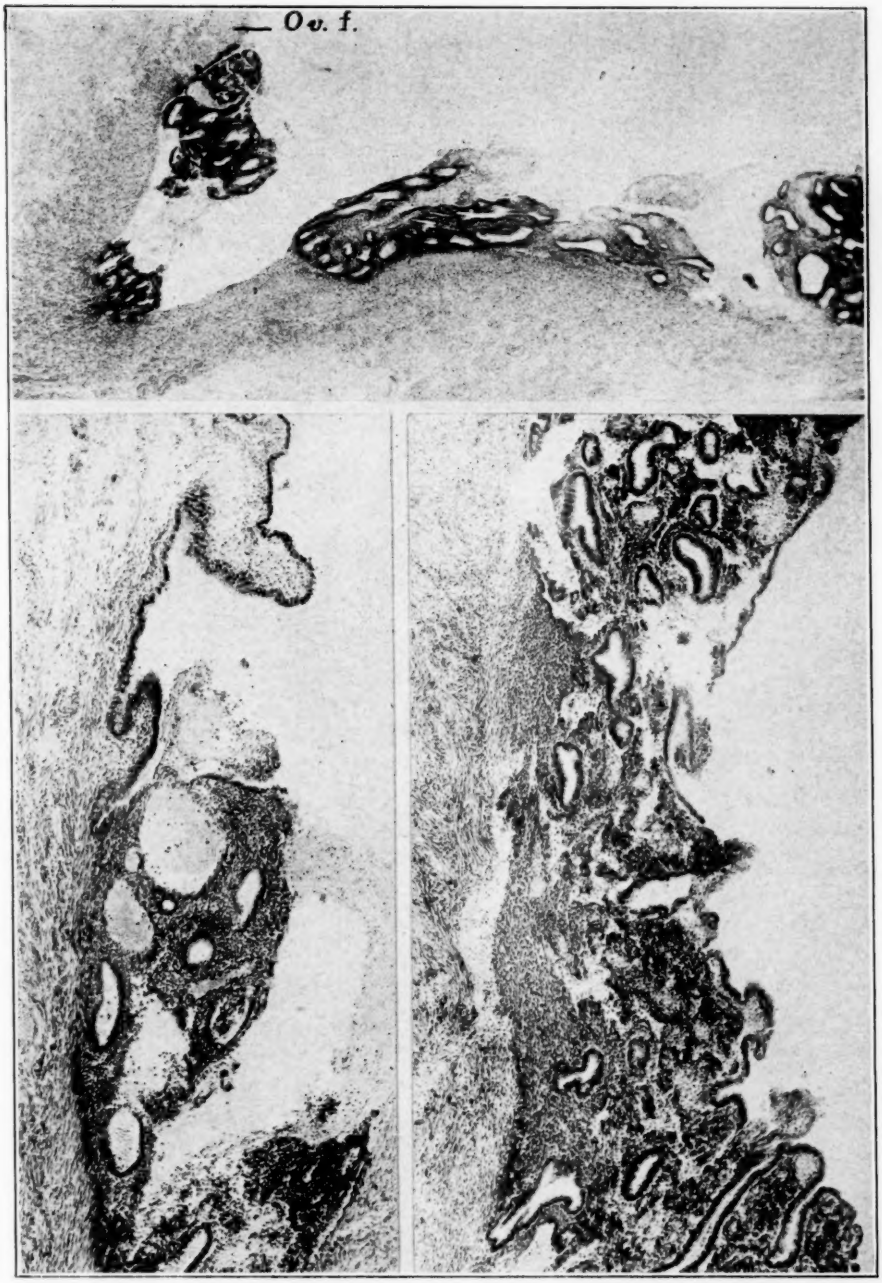

Fig. 27.—Three photomicrographs (the first ×25 and the others ×60). The first one is of a higher magnification of the patches of endometriosis extending from the base of the ovarian fimbriae, *"Ov. fim.,"* over the surface of the mesosalpinx and ovary shown in Fig. 25. The second is of a higher magnification of the terminal portion of the ovarian fimbria shown in Fig. 26, better demonstrating the development of the fimbrial endometriosis from the tubal mucosa than in the first section which was badly torn at this place. The normal fimbrial mucosa is shown above and the differentiated mucosa below. The third is of a portion of the lining of the ovarian endometrial cyst shown in Fig. 25. The operation occurred on the third day of the patient's menstrual period which usually lasted seven or eight days. The differentiated müllerian mucosa arising from the tubal fimbriae and that lining the ovarian cyst show the same reaction to menstruation with evidence of a loss of müllerian tissue including epithelium. Bits of müllerian tissue escaping from this menstruating tubal mucosa should have the same potentialities of implantation as similar tissue escaping from the ovarian cyst. It is conceivable that the endometriosis arising from the tubal fimbriae is the primary lesion and by direct extension or implantation caused the endometriosis to spread from the fimbriae over the surface of the mesosalpinx and the ovary. If true, the endometrial cyst of the ovary (Fig. 25) probably arose from this source.

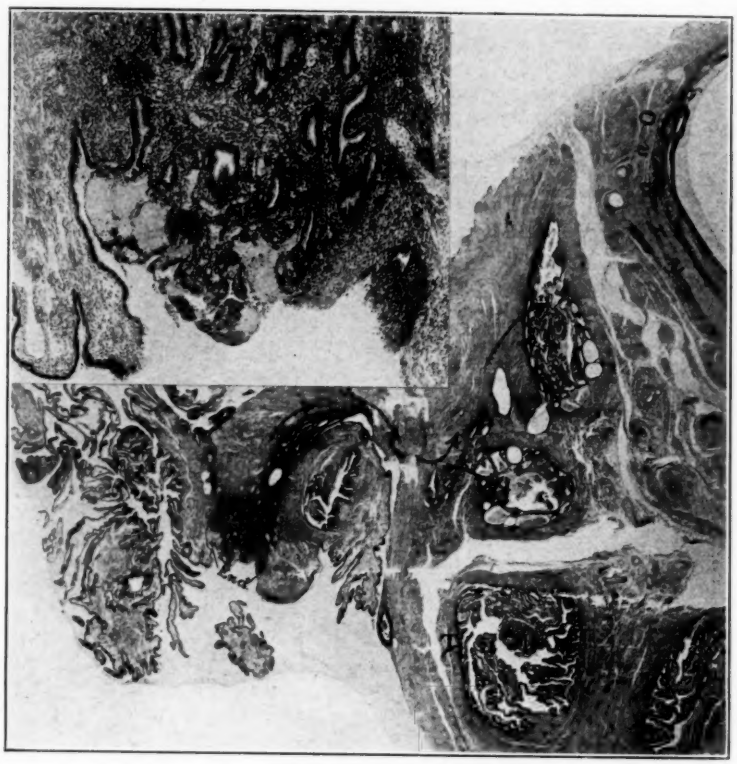

Fig. 28.

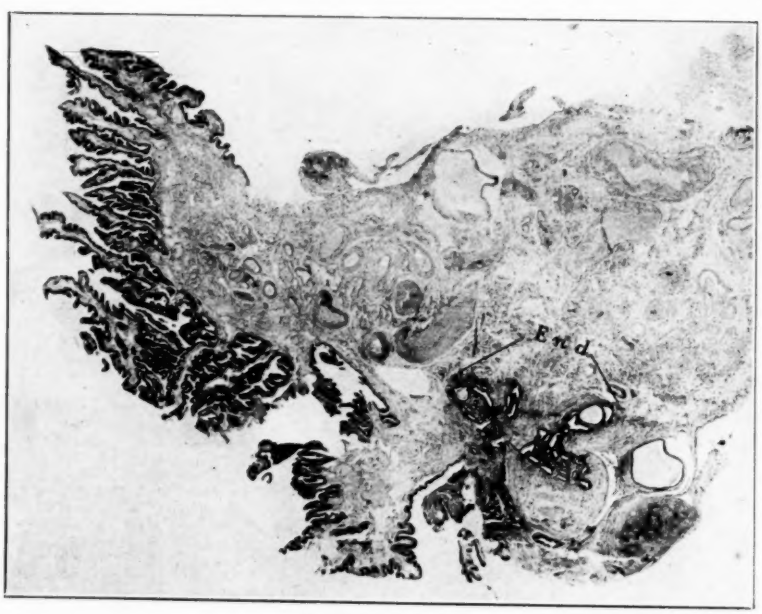

Fig. 29.

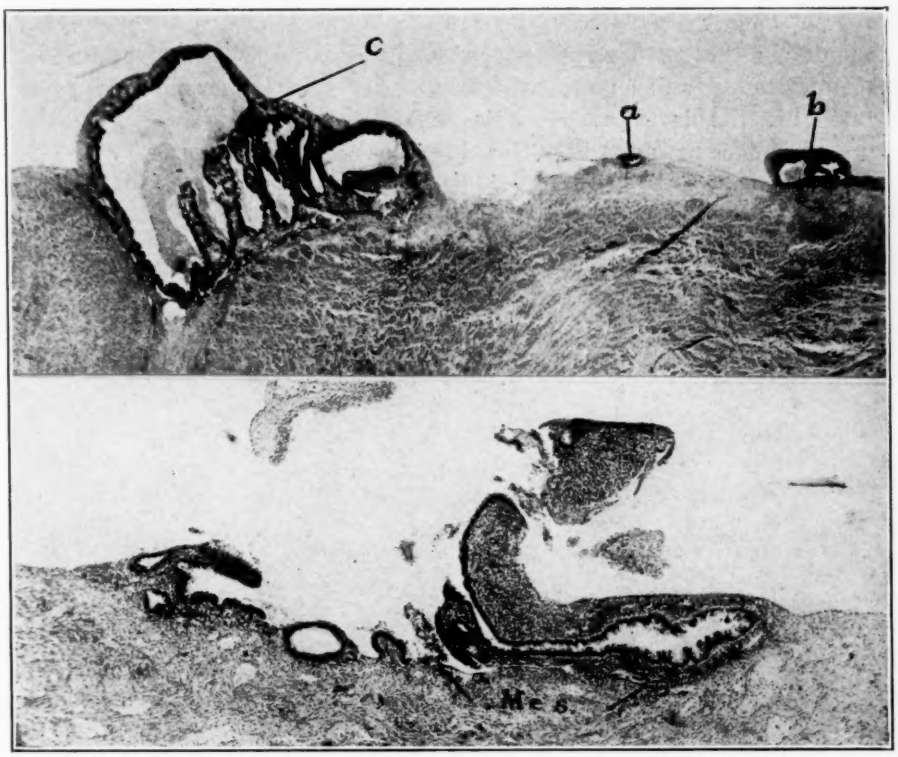

Fig. 30.

Fig. 28.—Photomicrograph (×8) of a section from the same block as the section shown in Fig. 25, but at a different level. Endometriosis, *"End.,"* has developed in the terminal portion of the fimbrial mucosa (see insert). The insert is of a (×45) magnification of the area *"End."* of the larger photomicrograph. Normal fimbriae are present at the left. Endometriosis has developed in the terminal portion of their mucosa. A characteristic reaction to menstruation is present in this differentiated mucosa with evidence of blood having escaped into the peritoneal cavity, and a resulting loss of the surface epithelium as in Fig. 27. The fimbrial endometriosis in this section is on the opposite side of the tube from that shown in Fig. 26. A small amount of blood was found in the pelvis at the operation and probably came from these menstruating fimbriae. The endometriosis in the mesosalpinx of Fig. 26 is also shown in the larger photomicrograph of this illustration—see arrows.

Fig. 29.—Photomicrograph (×8) of a longitudinal section of the fimbriated end of the tube lateral to its lumen (Case 8). Endometriosis *"End."* is present in the mesosalpinx, evidently having developed at the base of the ovarian fimbriae (see Fig. 40) at or near their mucoserosal junction. I was unable to trace its origin from either tubal epithelium or mesothelium. While I cannot exclude an implantation, circumstantial evidence indicates that it was derived from tubal mucosa.

Fig. 30.—Two photomicrographs illustrating peritoneal endometriosis of probable implantation origin on the surface of the uterus and a tubal fimbria (Case 9). The first (×10) shows three stages *(a, b,* and *c)* in the growth of müllerian implants on the anterior surface of the uterus near the origin of the left round ligament. For a higher magnification of implants *"a"* and *"b"* see Fig. 31. The second (×20) is of endometriosis on the dorsal surface of a peripheral tubal fimbria of the left tube. The endometriosis has developed on the surface of the fimbria covered by peritoneum. Mesothelial inclusions *"mes."* are situated beneath the right half of the implant. Evidently the capsule of the implant had been torn at the operation. I believe that, before the injury, the structure of this implant was similar to implant *"c"* shown above and that it had a like origin.

operation or by disease. I believe we can state that since injury and repair of operative trauma of the mucosa of tubal stumps are important factors in the development of endometriosis in this situation, in like manner injury and repair at the mucoserosal junction may be important factors in the development of the fimbrial endometriosis. Since endometriosis does not arise in all tubal stumps or in all or even a large per-

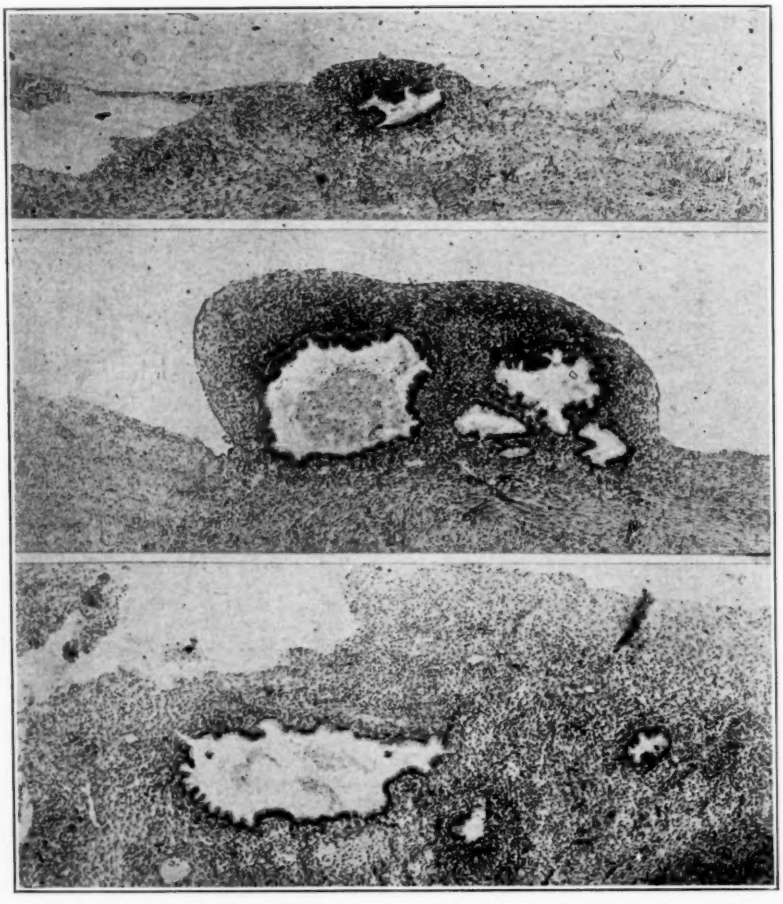

Fig. 31.—Three photomicrographs (×60). The first is of implant *"a"* and the second of implant *"b"* shown in the upper photomicrograph of the preceding illustration. The second implant appears older than the first. The third is of a section through an implant on the lower surface of the left ovary, from the same patient. The histologic structure of the three lesions is the same and therefore suggests a like origin. Their general structure is identical with that resulting from the healing of wounds caused by foreign bodies lodging on the peritoneum with the retention of these bodies in the scar of the wound caused by them (see Fig. 32).

centage of tubal fimbriae we must conclude that additional factors are essential for its development.

Can it be shown that the primary fimbrial endometriosis which usually appears to develop at or near the mucoserosal junction of fimbriae, arises only from tubal epithelium and not from the near-by mesothelium? In nearly all cases of fimbrial endometriosis of this type which I have

studied, the surface epithelium of the differentiated müllerian mucosa was continuous with that of the normal mucosa of the fimbriae and in not a single instance could it be shown that it arose from the mesothelium (Figs. 18, 21 and 23). In two instances in which I was unable to demonstrate the continuity of the surface epithelium in the two conditions this epithelium was lacking at the junction due to a menstrual reaction in one instance and possibly to the trauma of operation in another. Could primary fimbrial endometriosis be of other origin and arise from

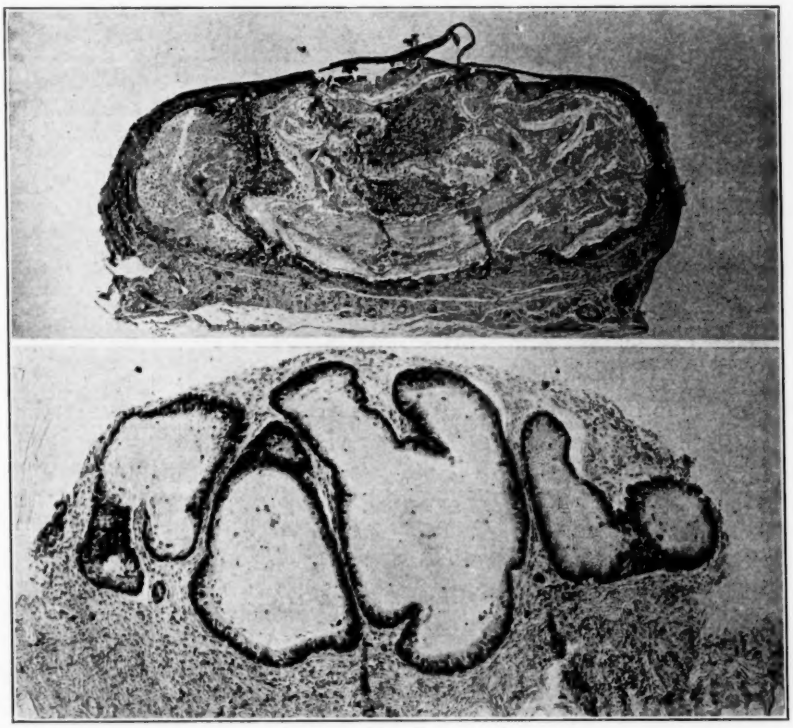

Fig. 32.—Two photomicrographs; the first (×25) is of a section of a nodule on the anterior wall of the stomach caused by the encapsulation of food (oatmeal) escaping through a perforated duodenal ulcer, and the second (×60) is of an implant on the under surface of the diaphragm secondary to cancer cells escaping into the peritoneal cavity from an ovarian cancer (see Figs. 1 and 43 of a previous paper[1]). The reactions caused by these foreign bodies lodging on the surface of the peritoneum are identical with those shown in Fig. 31. Therefore we are tempted to designate at least some of the encapsulated patches of cancer and müllerian epithelium on the surface of the peritoneum as implantations of foreign body type.

the implantation, in this situation, of epithelium escaping from the uterine cavity or from endometriosis of the ovary? If so, it is impossible to detect the place of fusion of the surface epithelium of the implant or graft with that of the tubal mucosa of the fimbria.

Is primary fimbrial endometriosis the result or the cause of the pelvic endometriosis usually present in such cases? In one instance the only endometriosis found, other than fimbrial, was situated in the tubal wall beneath the differentiated mucosa of the tubal fimbria and apparently

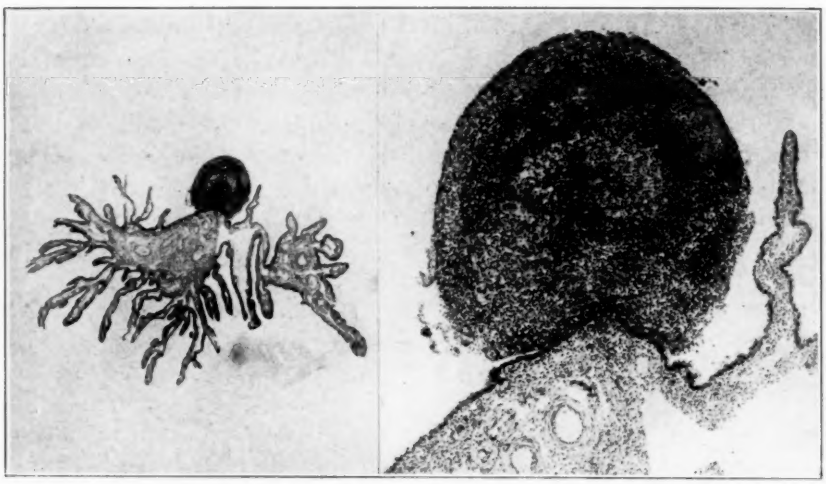

Fig. 33.—Two photomicrographs, the first (×8) is of a cross section of a portion of the fimbriae of the right tube showing a small nodule of granulation tissue on the palmar surface of the fimbria (Case 10). The second is of a (×45) magnification of the nodule shown in the first photomicrograph. There has been a loss of epithelium at the origin of the granulation tissue from the fimbria. Many such nodules were present on the palmar surfaces of the tubal fimbriae (see Fig. 40). None were observed on the fimbriae of the left tube: they might have been missed as the tube was not removed. A similar but larger patch of granulation tissue was found arising from the mucosa of the ampulla of the right tube which was first thought to be a fragment of endometrial tissue and so described. The patient had peritoneal endometriosis and was operated on the second day of her menstrual period. I do not know the significance of the localized areas of granulation tissue.

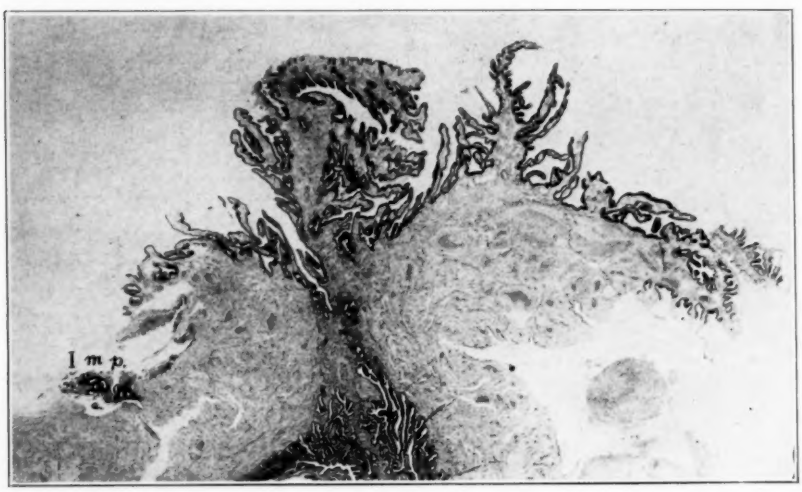

Fig. 34.—Photomicrograph (×8) of a longitudinal section of the fimbriated end of the left tube through its lumen (Case 11). Endometriosis "*Imp.*" is present on the surface of the tube distal to the base of the fimbriae (see Fig. 35).

Fig. 35.—Three photomicrographs demonstrating a possible origin of the endometriosis shown in Fig. 34. The first (×60) is of the fimbrial mucoserosal junction proximal to the endometriosis mentioned above and from the same section. Normal fimbriae are shown above covered by tubal mucosa. However, there is an evident loss of some of the epithelium covering the terminal portion "*Ter. p. m.*" of this mucosa. The serosal surface of the tube is covered by mesothelium, the cells of which are higher than normal in this situation but do not resemble the tubal epithelium. A gap between the terminal portion of the tubal mucosa and that of the mesothelium is partially filled with granulation tissue. From this area an exudate (see arrow) is

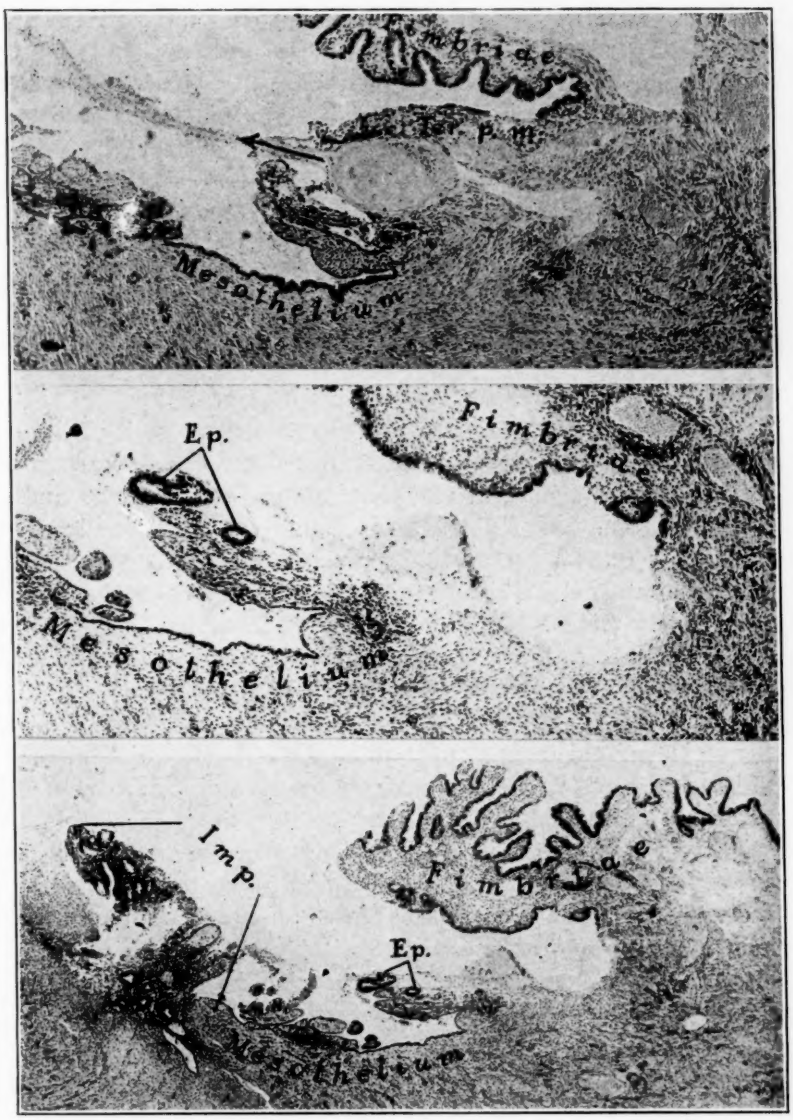

Fig. 35.

escaping into the peritoneal cavity and might have carried epithelium with it. The second photomicrograph (×60) is of the same area shown above, at a different level, but very near the preceding section. One can readily see the structures shown in the first section, namely, the fimbrial mucosa covered by epithelium and the serosa by mesothelium. There has been evidently a loss of epithelium. The surface of this raw area is covered by an exudate with two gland-like inclusions of epithelium *"Ep."* the upper one is enmeshed in fibrin and the lower one partially embedded in granulation tissue. I am tempted to infer that the epithelium forming these glands was cast off from the terminal portion of the fimbrial mucosa as indicated in this and the first photomicrograph, and that later it might give rise to a patch of endometriosis *"Imp."* similar to that in the third photomicrograph. This last photomicrograph is (×25) a magnification of the section shown above and including the area of the latter. Three stages are represented in the development of this implant *"Imp."* the escape of epithelium from the terminal portion of the fimbrial mucosa, the fixation of the epithelium in fibrin, its embedding in granulation tissue by the organization of the fibrin and finally the finished implant which is of the foreign body type.

arose from the latter by direct extension (see Case 4 and Figs. 13 and 14).

This case and others reported in this paper (see Cases 3, 5, 6, and 7) have convinced me that primary fimbrial endometriosis, at least in some instances, is the cause of the associated pelvic endometriosis.

It has been shown that müllerian epithelium carried with menstrual blood may escape from or through the tubes into the peritoneal cavity from the following sources:

1. The mucosa lining the uterine cavity.
2. The mucosa lining the tube, as suggested by the incidence of hemosalpinx in patients with pelvic endometriosis when the fimbriated ends of one or both tubes are occluded and also by the presence of patches of uterine mucosa in patent tubes.
3. Primary fimbrial endometriosis.

Can epithelium be disseminated into the peritoneal cavity from tubal fimbriae by any other phenomenon than the menstrual reaction of a primary tubal endometriosis? In Case 10 (see also Figs. 33 and 41), small areas of granulation tissue were found on the palmar surface of the tubal fimbriae of a patient with pelvic endometriosis operated upon during her menstrual period. I have recently encountered a like case occurring under similar conditions. I do not know its significance, but it indicates that there must have been a loss of tubal epithelium over these areas.

During the study of tubal stumps, endometriosis was found occasionally in the stump or in structures adherent to it, which was shown not to be continuous with the mucosa of the stump. These were interpreted as having possibly arisen from the growth of tubal epithelium transplanted by the surgeon at the original operation, unless they were present prior to that operation. If tubal epithelium transplanted by the surgeon sometimes grows and becomes differentiated into mucosa of uterine type, we would expect that tubal epithelium escaping from the fimbrial mucosa as the result of nonoperative trauma other than the menstrual reaction of fimbrial endometriosis might do the same. The

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Fig. 36.—Painting of a lateral view of the right tube, mesosalpinx and ovary (Case 1) showing primary fimbrial endometriosis "*e.*" arising in tubal mucosa which had spread over the surface of the mesosalpinx from the base of the ovarian fimbriae (see Figs. 6 and 7).

Fig. 37.—Painting of the fimbriated end of the right tube and a portion of the wall of an endometrial cyst beneath it (Case 2). Two patches of endometriosis "*e.*" are shown. The upper one is a primary fimbrial endometriosis (Figs. 8 and 9), and the lower one is probably a secondary endometriosis of implantation origin.

Fig. 38.—Painting of a lateral view of the right tube, mesosalpinx and ovary (Case 3) showing a primary fimbrial endometriosis "*e.*" with invasion of the mesosalpinx (see Figs. 10, 11, and 12).

Fig. 39.—Painting of the fimbriated end of the right tube with multiple hemorrhagic fimbriae due to an early menstrual reaction in primary endometrioses of these fimbriae (Case 4, see Figs. 13, 14 and 15). The patient (Case 11) was operated upon twelve hours after the onset of menstruation. An accessory fimbrial opening is present proximal to the main one.

Fig. 40.—Painting of a posterior or mesial view of the right tube and ovary (Case 8). The ovary containing an endometrial cyst is turned upwards exposing the opening in its lateral wall caused by freeing the ovary at the operation. The primary fimbrial endometriosis (Fig. 29) is situated at the base of the ovarian fimbriae. The patient was operated upon in the interval stage of the menstrual cycle.

Fig. 41.—Painting of the fimbriated end of the right tube (Case 10) showing small nodules of granulation tissue on the palmar surfaces of the fimbriae. The patient was operated upon the second day of her menstrual period. The bright colored nodules (Fig. 33) are of recent origin possibly due to the present menstrual reaction. The grey colored nodules on the upper fimbriae may represent a later stage of the others, possibly caused by a previous menstrual reaction.

Fig. 36.

Fig. 37.

Fig. 38.

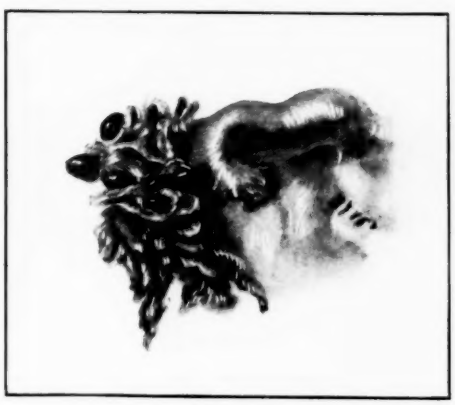

Fig. 39.

Fig. 40.

Fig. 41.

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possibility of this is suggested in the study of the reactions occurring at the mucoserosal junction, where one frequently finds evidence of the loss of the epithelium (Fig. 3), or of its having been embedded in adjacent tissues (see Fig. 4). This possibility is strengthened by the condition found in Case 11 (see also Figs. 34 and 35 and their legends).

SUMMARY

Primary fimbrial endometriosis develops from the activation and differentiation of the tubal mucosa of the fimbriae into a structure (growth) resembling endometrium. A like condition may arise in the mucosa of the ampulla of the tube. These are distinct pathologic entites which may be grouped with primary uterine endometriosis (uterine adenomyoma of mucosal origin and adenomyosis interna), primary endosalpingiosis and endometriosis arising from the mucosa of the proximal portion of the tube, postoperative endometriosis continuous with the uterine mucosa and also postsalpingectomy endosalpingiosis continuous with the tubal mucosa. They should not be grouped with the various forms of misplaced müllerian mucosa not in continuity with the mucosa lining the uterus and tubes.

I realize that all misplaced müllerian tissue derived from tubal mucosa, etiologically, should be designated as endosalpingeal, but when it becomes differentiated into a structure resembling endometrium I am tempted naturally to call it endometrial.

Primary fimbrial endometriosis may invade or spread over the surfaces of the wall of the tube and mesosalpinx. When it arises in ovarian fimbriae it may likewise involve the ovary and even cause endometrial cysts of that organ. This differentiated mucosa reacts to menstruation and since it is exposed (unencapsulated) to the peritoneal cavity, menstrual blood, carrying with it bits of müllerian tissue, readily escapes into the pelvis. This disseminated tissue should possess the same potentialities of implantation as similar tissue escaping from ovarian endometriosis. Primary fimbrial endometriosis, therefore, is one of the varieties of endometriosis from which pelvic endometriosis in other situations may arise by extension and dissemination. The frequency and importance of this variety in the life history of pelvic endometriosis has not been determined.

Primary endometriosis probably arises in any part of the fimbrial mucosa. In my experience it has developed in the terminal portion of this mucosa at or near the mucoserosal junction, in all instances in which I have been able to determine the exact site of its origin. The abrupt termination of the tubal mucosa at this point, often with a definite gap between its epithelium and the mesothelium of the serosa, constitutes a vulnerable and unstable area. This is manifested by evidence of injury or stimulation with loss of epithelium and reactions indicating repair of an injury, even in normal appearing tubes. The conditions found in this situation may resemble those encountered in the re-

pair of the mucosa in the severed ends of salpingectomy stumps. I believe that trauma and repair of injured tubal mucosa constitute important factors in the etiology of endometriosis at the mucoserosal junction of tubal fimbriae and in and about salpingectomy stumps.

A study of conditions often present at the mucoserosal junction, other than endometriosis, indicates that epithelium is sometimes disseminated from the terminal portion of the fimbrial mucosa by reactions, the cause of which I do not fully comprehend. Could this extruded epithelium possibly cause endometriosis by implantation? This is only one of the many unsolved problems relating to pelvic endometriosis.

Many data have been collected which should be considered in determining the etiology of müllerian mucosa on the surfaces of the ovaries and peritoneum. A few of them I wish to enumerate and some I shall discuss briefly.

1. The frequency of tubal patency and the incidence of hematosalpinx when one or both tubes are occluded.

2. The distribution of the early lesions in situations accessible to material escaping from the tubes and in sites where this material might be retained.

3. Their character, often indicating a local reaction to an injury caused by some foreign body and the repair of that injury.

4. The significance of menstrual blood both in the etiology and dissemination of pelvic endometriosis.

5. The structure of the epithelial "growths" in these lesions is the same as that of the tubal and uterine mucosa from which the material causing the lesions was derived.

6. The lesions of pelvic endometriosis, including ovarian, and endometrial cysts not in continuity with the tubal mucosa, are similar to those arising from the invasion of these structures by the activated mucosa of tubal stumps and of primary fimbrial endometriosis, the only difference being a break in continuity between the müllerian mucosa in the primary and secondary situations. By what phenomena can the spanning of this break be explained?

7. The various stages in the development of peritoneal endometriosis correspond with similar stages in the development of peritoneal carcinomatosis of accepted implantation origin.

Both uterine and tubal epithelium at times escape through patent tubes from müllerian mucosa, a tissue frequently possessing the invasive traits of cancer. Tubal and uterine epithelium sometimes becomes activated as the result of trauma and repair, causing endometriosis under these circumstances (tubal stumps, mucoserosal junction of fimbriae and incised wound of the uterus). Therefore I believe it possible that a similar repair of injury, arising from the traumatized (and therefore sometimes activated) epithelium escaping from or through patent tubes, may result in endometriosis on the surface of the various pelvic structures on which this activated epithelium lodges. Occasionally similar lesions apparently arise from müllerian epithelium transplanted during operations on the tubes and uterus.

On the other hand the supporters of the metaplasia theory for the

origin of pelvic endometriosis other than that in continuity with the mucosa lining the tubes and uterus, may claim that I have given them excellent ammunition with which to shatter the implantation theory. Since tubal mucosa may become differentiated into endometrium-like tissue, it is their privilege to assert that mesothelium and the surface epithelium of the ovary, also derivatives of the celomic epithelium, could become differentiated into either uterine or tubal mucosa if activated by the proper stimulant and that such a stimulant may be present in material escaping from or through the tubes. Sometimes endometriosis on the surface of the various pelvic structures is not encapsulated and closely resembles the differentiated mucosa of a primary fimbrial endometriosis, hence why not a primary mesothelial endometriosis in such cases? I would expect that this might occur in patches of tubal mucosa should the latter be present in these situations. I have demonstrated this phenomenon in tubal epithelium which had spread over the surfaces of the tube, mesosalpinx and ovary from the fimbriae. We must not lose sight of the fact that a similar type of lesion also occurs in peritoneal carcinomatosis and that the surface of skin grafts, even very small ones, is uncovered.

The general laws governing the healing of wounds of the various structures and organs are the same whether caused by the surgeon or by disease. A comparative study of peritoneal endometriosis and peritoneal carcinomatosis demonstrates that in each one sees the histologic structure of the parent tissue (müllerian mucosa in one instance and cancer in the other) from which they have arisen as the result of something escaping into the peritoneal cavity. The same study convinces one that not only are the histologic pictures of the various stages in the development of the peritoneal lesions in the two conditions similar but also their end results. Therefore one is tempted to believe that the fundamental method of origin of the secondary growths is the same in each instance.

If endometriosis arises from a differentiation of the mesothelium due to some stimulant escaping through the tubes we well might infer that peritoneal carcinomatosis might arise from a differentiation of the mesothelium caused by some substance escaping from the parent cancer. Even if this be true, as is possible in some instances, it does not prove that all of the lesions of peritoneal endometriosis and carcinomatosis arise in this manner and that implantation is not the chief method of their origin. Our present conception of metastatic cancer is based on the transplantation (implantation) of cancer cells escaping from the primary tumor.

NOTE: The paintings from which the color plate was made, which portray primary fimbrial endometriosis far better than any verbal description, were made by Mrs. M. R. Marden. The photomicrographs were made by Mr. James A. Glenn. The demonstration of the origin and extension of these lesions was greatly facilitated by the technical skill and care of Miss Isabel Peck. Dr. Victor C. Jacobsen made valuable suggestions and criticisms. These I thank for their interest and cooperation.

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THE DIAGNOSTIC VALUE OF RADIOPAQUE CONTRAST MEDIA IN GYNECOLOGY AND OBSTETRICS*

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THE beneficent discovery of the roentgen ray in 1895 has illuminated practically every field of medicine. In gynecology and obstetrics, both from a diagnostic and therapeutic standpoint, it has been of immeasurable value.

It is interesting to note that in gynecology the x-ray was first used as a therapeutic agent and later employed for diagnostic purposes, while in obstetrics it was first used as a diagnostic measure, and even today its use as a therapeutic agent has no rational basis.

There is some doubt to whom credit should be accorded for the conception of introducing radiopaque contrast media into the genital tract for purposes of roentgen diagnosis. Cary, of our own country, published the first report in March, 1914, while Rubin published his observations in May of the same year. Dartigues and Dimier of France maintain that they used it before that date, but because of the war were unable to publish their results until 1916.

The question of precedence is of little consequence, but the use of contrast media in the genital tract was epochal, and gynecologists soon saw the possibilities of diagnostic achievement, in the hope that an innocuous radiopaque substance could be found with which gynecologic diagnosis could approach, and even exceed, in accuracy that which has been accomplished by the use of barium in the gastrointestinal tract.

Since 1914, when Cary and others used collargol, various other radiopaque substances have been introduced into the genital tract for diagnostic purposes. Among those were sodium bromide, sodium iodide,

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strontium iodide, lithium iodide (umbrenal), bromide oil, bromized oil (contrastol), rapeseed oil (campoidal), etc. With few exceptions these preparations proved to be objectionable because of their irritating and toxic qualities. Some serious complications and even fatal results have been reported following the exhibition of these preparations. It was not until 1925 that Carlos Heuser, of South America, reported the first use of lipiodol in his sterility studies and in the early diagnosis of pregnancy.

Since the use of lipiodol in the field of gynecologic diagnosis, there has appeared a voluminous amount of literature concerning it. After a careful survey one comes to the conclusion that, in a general way, lipiodol is, at the present time, the preparation of choice. After its use in thousands of cases by gynecologists from many different countries, one cannot escape the conclusion that this preparation, which is so impermeable to the x-ray, is nonirritating, nontoxic, and that it can be administered with a minimum amount of discomfort and danger to the patient.

One may state today that lipiodol is a standard preparation which is being used in uterosalpingography and that all other radiopaque substances have been largely abandoned because of their irritating and toxic qualities.

Irving S. Stein, who has had a large experience with x-ray pneumoperitoneum, has used lipiodol in conjunction with it in over two hundred cases, and he believes that the combination of these two procedures is of striking diagnostic value in gynecology and obstetrics.

It is not the purpose of this presentation to discuss the merits of gas insufflation as compared to those of radiopaque media in gynecology and obstetrics. The original, brilliant, and exhaustive amount of work which has been done by Rubin on uterotubal insufflation is of monumental significance; and it has associated his name with the extensive literature on sterility and tubal impermeability. The writers believe that both tubal insufflation and uterosalpingography have their proper place in the diagnosis of abnormalities of the genital tract. Many gynecologists use both methods, many favor the Rubin method, while many others, especially the French school, favor the radiopaque injection.

The senior writer can only state that after acquainting himself with the technic of tubal insufflation and following its practice for a period of five years, he has practically abandoned it in favor of lipiodol injection, and that during the last five years he has rarely done a gas insufflation. While the writer had no untoward occurrences as the result of tubal insufflation, except in one case of ectopic pregnancy, which he does not believe can be proved to be the result of the insufflation, he believes that in his own personal experience, lipiodol has proved much more satisfactory than the Rubin method, and that results which he has obtained from its use are more positively informative than those which were obtained by the use of gas.

When in the field of gynecology and obstetrics a comparatively new diagnostic procedure is suggested, which involves the entrance of a foreign substance into the inner genitalia, which nature has guarded with certain defense barriers, the physician's natural reactions suggest the following questions:

1. What is the danger attending such procedure?
2. How much pain and disability will this measure cost the patient?
3. Has the test been done in a sufficient number of cases, and with such a satisfactory technic that conclusions of value may be drawn from it?
4. What information can be obtained that cannot be gained by a careful gynecologic examination, made under anesthesia if necessary?
5. Can its field of usefulness be extended toward more precise diagnosis in gynecology and obstetrics?

The dangers attending uterosalpingography, assuming the use of a proper technic, are practically always avoidable, granting that the physician carefully examines the patient and excludes all cases who present the following conditions:

1. Active genital tract infection.
2. Leucocytosis and fever.
3. Recent extensive uterine bleeding.
4. Premenstrual, comenstrual, and immediate postmenstrual periods.
5. Pregnancy, normal and extrauterine.
6. Any disease rendering a patient acutely ill or any severe constitutional ailment.

The danger of introducing a foreign body into the genital tract in the presence of active infection is too obvious to require more than passing comment; the possibility of forcing organisms and infectious material through the fallopian tubes into the peritoneal cavity must be ever present when performing a uterosalpingography. Local peritonitis, general peritonitis, and deaths have occurred from this procedure and undoubtedly will occur if the greatest care is not exercised, and especially if this work should become a current practice among physicians who are not trained gynecologists.

A microscopic examination of the vaginal and cervical flora should precede every examination.

Inasmuch as this test is never an emergency measure, no patient should be submitted to it when there is any suspicion of the presence of infection or other unfavorable condition. It is much better to wait for weeks, if necessary, than to awaken an infection that may last for several months.

If the patient has had a recent, extensive uterine hemorrhage there is danger of infection and there is a possibility of oil embolism. Furthermore, there is danger of improper interpretation of the roentgenogram which might be occasioned by the presence of blood clots.

Early in this work it was suggested by Rubin, and verified by others, that the mucous membrane of the inner genitalia is more suitable for gas insufflation and for uterosalpingography from five to ten days after

completion of the monthly period. At this time there is less danger of infection, less danger of physiologic blockage and there is more probability that there will be a more normal physiologic response of the uterus and tubes to the opaque media.

One of the definite contraindications to the use of uterosalpingography is pregnancy, notwithstanding the fact that Heuser and several other observers made the statement early in this work that it will not result in abortion.

It is obvious that no intelligent physician would submit any sick woman (irrespective of the nature of her illness) to this delicate test which, under the most favorable circumstances, is only practiced on a comparatively small group of women.

The introduction of radiopaque media into the genital tract always produces some discomfort to the patient. However, with the use of fresh, clear, and warm lipiodol and by the use of a standardized technic in which the utmost gentleness and delicacy are employed, pain is negligible, in a woman possessing an ordinary, stable nervous system. In our own work we rarely employ a narcotic preceding, during, or following the test.

Our patients are required to remain in the Clinic for about eight hours during the first day of the test, and to return in twenty-four hours for a control picture, which can be made in a very few moments.

What information can be obtained from the above test that cannot be gained by a very careful gynecologic examination, made under anesthesia, if necessary?

The supreme diagnostic value of the use of radiopaque media in the genital tract is that it gives us precise information as to the patency or nonpatency of the fallopian tubes and the location of the blockage when present. In cases of sterility, where the most careful bimanual examination made by the most competent gynecologists fails to reveal tubal pathology, even with the patient under an anesthetic, this test finds its greatest usefulness.

Until tubal insufflation and salpingography were introduced there was no way of ascertaining the presence or absence of tubal blockage without opening the abdomen, and even then the information that was obtained was not as reliable as that which can be obtained by uterosalpingography. Many hundreds of cases have been checked on the operating table to prove the accuracy of salpingography. Comparisons have also been made at autopsy in verification of the dependability of this test.

In fact, if this measure never accomplished any more than the diagnosis of the presence and the location of organic tubal obstruction, with the added number of cases of pregnancy that have followed it, it will be considered as one of the most notable gynecologic accomplishments during the last quarter of a century.

While errors of interpretation in uterosalpingography have occurred

and will occur, these errors will be reduced to a minimum as the work proceeds. When a standard technic becomes a matter of general practice and when the roentgenograms from the various Clinics are compared, the use and dependability of the test will be gradually extended.

It seems to the writers from an extensive review of the literature, and from their own personal experience, that a most attractive field of investigation challenges the gynecologists and radiologists who should work in the closest cooperation in this comparatively new field of diagnosis.

In addition to its value in determining the presence and location of tubal occlusion, uterosalpingography offers itself to the following conditions, in a practical way:

1. Exact size, shape, contour, and tonicity of the uterus.
2. Presence of intrauterine tumors.
3. Presence of adnexal tumors, such as hydrosalpinx, ovarian cysts, etc.
4. Presence of salpingian adhesions due to extragenital pathology.
5. Presence of anomalies of uterine and tubal development.
6. Differentiation between the genital tract pathology and that in the region of the cecum and sigmoid.
7. Diagnostic check on results of tubal reparative surgery.

Radiopaque contrast media may be introduced into the genital tract for diagnostic purposes either by the open or the closed method. Dyroff advocated a very slow, drop by drop, introduction, leaving the cervical canal open, and he observed that the tubes became filled, not from the pressure but from uterine contraction. He observed through the fluoroscope the contrast medium running out of the tubes, drop by drop, toward the lateral pelvic walls, and he demonstrated that the oil was driven by the tubes into the peritoneal cavity. He was the first to show by films the segmented filling of the tubes, which gives the appearance on the films of a string of beads. About the same time that Dyroff made this observation, others such as Gregoire, Darbois, and Béclère observed that the tubes dilate and contract irregularly.

Schneider and Eisler observed that in the closed method, when the media is introduced, the uterus contracts in various ways, and they stated that the oil is driven to its destination by uterine contraction and tubal peristalsis. They noticed the disappearance of one uterine horn while the opposite one dilated; they also noted alternating changes in form of the fundus. They stated that, under the fluoroscope the media forms a round or pear-shaped shadow, and after the fundus becomes filled, the isthmus becomes filled, making a funnel-shaped shadow. In a few minutes the tubes are filled in their whole course. Schneider and Eisler believe that this is a physiologic response of the uterus and tubes to the contrast media.

These authors suggest that in hysterosalpingography the function of the fallopian tube may be studied in relation to ovulation and that, as a result of these researches, some therapeutic measures may be forthcoming. They suggest that these studies may help in an understanding in both the function of the tubes and the physiology of gestation. They warn, as do other authors, about the danger of misinterpretation of findings as regard shadows due to other conditions, such as phleboliths, vesical, and ureteral stones, calcified ovarian and calcified fibroid tumors, and dermoid cysts with bone formation.

Schultze, in considering the basis of hysterosalpingography, states that constitu-

tional conditions of the uterus determine its response to a filling media. In an atonic uterus, for instance, the angles are rounded and the definitely triangular figure seen in the normal condition, is missing; therefore, it requires more media to fill the cavity. Schultze states that a normal sized uterus generally does not require more than 7 c.c. to fill it, and if it then fails to show a clean-cut triangle, with sharp corners, one may assume that there is a uterus with decreased tone and a yielding wall. He states, however, that there are variations in the form of the uterus which are within normal limits and that unless one has a complete filling the tubes may not fill and erroneous interpretations are possible.

Schultze says that it is essentially the contraction of the uterus which fills the tubes with contrast media, and he has observed that the two tubes do not fill synchronously, in the majority of cases.

He distinguishes three stages of the filling process of the tubes, the first state is the passage of the oil from the uterus to the ampulla, which occurs very rapidly, so rapidly that one seldom sees it; the second stage represents a slight delay of the oil at the fimbriated end; and the third, the passage of the oil through the fimbriated extremity into the peritoneal cavity.

He believes that the transport disturbance of the tube may be due to adhesions or inflammatory thickening of the wall but thinks that an impermeability can exist on a purely functional basis. He warns that the true diagnostic value of this test will only be attained after a long comparison of films and by following the clinical course of cases and by laparotomy findings.

Schultze suggests that our aim in the future should be toward determining how much negative films rule out pathologic changes.

We believe that in the future some radiopaque medium may be discovered that will permit of a more positive detail than that which can be obtained by lipiodol, and thereby make negative film findings more positively exclusive of tubal pathology.

In our own work we have observed how rapidly the uterus will sometimes propel the opaque media into the abdominal cavity, and we believe that during a process of filling the uterus one film should be taken. On the other hand, sometimes the oil remains in the uterus for an hour or two, if not longer, before entering the tubes. We, therefore, believe that to avoid error of interpretation, films should be taken during the filling process and at various other intervals, and that the cervix should be kept closed for a considerable time after the introduction of the media.

Reinberg and Arnstam state that they have discovered, by use of radiopaque media, some important facts concerning the anatomy and physiology of the fallopian tubes; they say that the fluoroscope may play only an unimportant rôle in this work, that the cinematograph is not yet perfected, and that, at the present time, the repeated taking of films is the most practical. They believe that the form of the uterus depends on the muscular tonicity and the position of this organ in the pelvis. They believe that the usual capacity of the uterus is from 3 to 4 c.c., while the hypoplastic type may have a capacity of only 2 to 2½ c.c.

These authors state that lipiodol under slight pressure produces a tonic contraction of the uterine walls. After introduction the lipiodol gathers around the end of the cannula and forms a spindle, and that after the addition of a larger amount, the expanding shadow takes the form of an isosceles triangle. This triangular shadow is characteristic of normal muscular tone and when a tonicity is present the cornua have rounded instead of angular corners. It seems as if the uterus, in an effort to rid itself of the contrast media, squirms and assumes various shapes, such as have

been described by Schneider and Eisler, Schultze, Reinberg and Arnstam, and other authors.

Reinberg and Arnstam describe a pendulum-like movement of varying amplitude, while the uterine wall moves upward and downward, and even tetanic movements have been noted. When the uterus is permitted to empty its contents into the vagina, the contractions may be rapid and jerky; they may occur immediately or they may be delayed.

When the uterus contracts metrosalpingographic observations show that the lipiodol is pushed into the abdominal cavity drop by drop as has been demonstrated under the fluoroscope. While there is some arrest at the fimbriated extremity, it is usually driven rapidly into the vagina. Reinberg and Arnstam state that they have discovered a sphincter at the uterine end of the tube, and Arnstam has obtained a photomicrograph of the same. These authors state that under normal conditions, the uterine and tubal cavities are either completely or partly shut off by contraction of muscular fibers, which are buried in the interstitial portion of the tube. When there is not a complete contraction the lipiodol may be seen like a thread connecting the two cavities. They believe that changes in the lumen described above are brought about by local, tonic contraction of the circular muscular fibers. These authors also suggest that uterosalpingographic studies may help to understand how the ovum is transported, and the part that tubal peristalsis plays, compared to the rôle played by the ciliated epithelium. Their studies with contrast media in the tubes lead them to believe that these organs are extremely movable, and that under normal conditions they change their form and position.

Reinberg and Arnstam state that their films have demonstrated clearly both an active peristalsis and an antiperistalsis, and that while the contrast media may be pushed toward the uterus, and also toward the fimbriated extremity, the usual peristalsis is from the cornua to the abdominal end. They believe that the tube plays more than a passive rôle in furnishing a transport tunnel and that there is a definite peristaltic contraction of the musculature present. They agree with other observers that the segmented, beady appearance of the tube as seen through the fluoroscope and on the film is due to peristaltic tubal activity.

Schultze, quoted by Cotte, states that there are two kinds of uterine contractions, namely, partial, in which different segments of the uterus function independently of each other, and which may be demonstrated by x-ray films taken in series; and second, complete contraction, due to the simultaneous operation of the body of the uterus and the horns.

From the standpoint of interpretation, Cotte suggests that one should keep in mind certain important points, namely, that the tubes cannot usually be seen in their entire course, excepting when they are obliterated at the fimbriated end; that the tube usually goes out from the uterus in a horizontal line; that in the isthmus, the contrast media looks like a filiform streak; that the situation of the tubes varies; that they may be situated low in the pelvis or suspended by reason of adhesions; that they are often folded and bent back upon themselves. And furthermore, that some uteri are hyperkinetic to the extent that as soon as the medium is introduced they expel it immediately, while other uteri may be so atonic that they hardly react to any amount of distention.

Nahmacher has observed that ordinarily the pressure in the uterus is not sufficient to force the fluid through the entire tube, especially since the ampullar end is but little dilated, and he, therefore, concludes that there must be active peristaltic action of the tubes toward the peritoneal cavity.

Jarcho states that, if the films are taken in series, one may find that the tubes are not filled at all, while in others they are filled in their entirety; or that they are filled only at the proximal end, or only at one of the distal portions. He further states that when tubes are not filled it may be due to insufficient contrast media in the

uterus, atony of the uterus, or spasmodic contraction of the cornua, or of the proximal portion of the tube. He and others have observed that even a few drops of the contrast medium introduced into the uterus will sometimes find their way into the tubes.

Schultze, studying the phenomena of uterosalpingography, devised a method by which he could take six serial views in a half a minute, and at the same time he watched the progress of the opaque medium and the behavior of the uterus and tubes. By this method he could change from screen to film and from film to screen as often as he wished. In this way it was possible to observe that the same uterus gave different shadows according to the amount of its filling.

Petit-Dutaillis states that adhesions of the tube, due to extragenital causes, such as appendicitis, can, by salpingography, be located and proper treatment instituted in certain cases of sterility, and that in these cases practical information can be obtained which cannot be gained in any other way.

The writers desire to make a plea for a more general standardization of the whole procedure, from the following standpoints:

1. Time of administration relative to menstruation.
2. The amount of contrast media used.
3. Routine use of the manometer.
4. Definite intervals between the taking of roentgenograms.
5. A control film always taken twenty-four hours after introduction of the contrast media.

The authors make the following recommendation in the above connection: First, the time of administration should be approximately one week following the cessation of the last menstruation and coitus should be interdicted meantime. Second, the amount of contrast media should be about 5 to 7½ c.c. Third, the introduction should be under the control of a manometer and the pressure should not exceed 250 mm. of mercury. Fourth, the first film should be taken during or immediately after the filling of the uterus, a second one ten minutes later, the third an hour later, a fourth four hours later, and a fifth at the end of twenty-four hours. Anteroposterior exposures should be frequently supplemented by roentgenogram in profile. We have found that a slightly oblique position instead of a true lateral is desirable.

Cornell and Warfield state that in the Cook County Hospital in Chicago the x-ray examinations have been made of all urinary complications during pregnancy and the puerperium. It is well known that normal woman during pregnancy, without any complaints, show a marked dilatation of the right ureter. Cornell and Warfield found that the left ureter showed a much less degree of dilatation but that the right one showed evidence of it from the third month on. These authors used skiodan, 20 gm., dissolved in 50 c.c. of sterile water. Films were exposed in ten minutes, thirty minutes, one hour, and four hours after injection. They found that the pathologic kidney is slow to visualize as compared to the normal and it retains the opaque material much longer. Cornell believes that the visualization of the urinary tract in normal pregnant women may show that accepted facts will have to be revised; these authors bring out the fact that this test offers a means of confirming urinary tract disease diagnosis without great discomfort to the patient and helps in a decision whether or not a patient should be examined with a cystoscope or catheterized. This method of kidney and ureter visualization marks another triumph for radiopaque media in the field of obstetrics.

The use of opaque media in obstetrics has received little attention from the profession at large. Except for the occasional use of lipiodol in the early diagnosis of normal and extrauterine pregnancy, no references were found in the literature in 1930. A study made in that year by some of us led to the use of contrast media in patients at or near term. Some interesting results were obtained. It was found that a water-soluble contrast medium could be injected into the amniotic sac with relatively little danger. The purpose of this study was to outline, if possible, the site of implantation of the placenta. This was found to show as a filling defect on the film.

The method employed involved the injection of an aqueous solution of strontium iodide prepared in the following manner: Ten grams is placed in a sterile flask with about 15 c.c. of sterile distilled water and brought to a boil. This dissolves the strontium iodide and at the same time a trace of an easily filtered precipitate of strontium carbonate may be thrown down. This precipitate is filtered off through sterile filter paper and a sterile funnel, into a second flask. The solution is then boiled slowly for ten minutes; it is allowed to cool and then is ready for injection.

The bladder is emptied. Careful palpation of the abdomen is used to determine the position and presentation; the position and rate of the fetal heart are recorded; the abdomen is carefully cleansed with iodine and alcohol from the umbilicus to the symphysis. Sterile towels are draped around this area; the operator puts on sterile gloves; a few cubic centimeters of one-half per cent novocaine is injected under the skin just to the right or left of the mid-line about halfway between the umbilicus and symphysis. The injection is usually made on the side where the fetal small parts are felt. A nineteen or twenty gauge Pitkin needle, with a stylet, is used. This needle is of the type that will bend without breaking and is used in spinal puncture work. The needle is inserted through the anterior abdominal and uterine walls. When the amniotic sac is entered a distinct snap is felt, as in doing a spinal puncture. The stylet is withdrawn. Very frequently amniotic fluid will flow back through the needle; sometimes blood is encountered. This is probably due to the fact that the point of the needle is in the placenta and one should insert the needle still farther.

A 10 c.c. syringe is now attached to the needle and the amniotic fluid withdrawn in an amount which is approximately equal to the amount of strontium iodide solution which one intends to inject. The strontium iodide solution is taken in a twenty or thirty cubic centimeter syringe and attached to the needle in the amniotic sac and amniotic fluid is withdrawn. This serves two purposes, one to be sure that the needle is in the amniotic sac, and the second to cause some dilution of the concentrated strontium iodide solution in the syringe. The iodide solution is injected and fluid is withdrawn alternately so that at no time is a large amount of concentrated solution being put into the amniotic sac.

When injection is completed the needle is withdrawn and a small sterile dressing applied, and the patient is instructed to lie on the left side for ten minutes, on the right side for ten minutes, and then on the back. This allows a diffusion of the strontium iodide through the amniotic fluid. The first x-ray is lateral, with technic as follows: one hundred ma., 80 to 85 K.V.P., time—three seconds on the Bucky; the patient is then turned and a posteroanterior is taken, with a hundred ma., 85 to 90 K.V.P., time—three seconds. An oblique is taken with about the same factors as is used on the P.A.

Certain observations of considerable theoretical interest have been made, including the fact that the infant swallows amniotic fluid in suf-

ficient quantities to outline the stomach and intestinal tract, the determination of loops of cord about the neck, and occasionally the determination of the sex of the fetus when the buttocks happens to appear in profile.

Two observations, however, appear to be of considerable practical importance: First, it is possible to obtain a distinct outline of the soft parts and in this way accurately estimate the relative size of the fetus and, thereby any disproportion, if such exists. Second, it offers a precise method of locating the placenta in cases of silent bleeding, without the usual dangers of contamination, attendant on vaginal examination.

At a meeting of this Society two years ago the senior author, in discussing Dr. Matthews' paper on the roentgen ray as an adjunct in obstetric diagnosis, referred to this work and stated, that the pictures in these cases were a great improvement on the ordinary film. He also stated that the work was not entirely devoid of danger and that it was too early to predicate the practicability of it, but that it was of extreme academic interest.

Certain physicians have reported a high fetal death rate following attempts at amniography. Careful investigation revealed the fact that these physicians were using, not strontium iodide, but sodium iodide. From our experience we believe that the use of sodium iodide in this work is dangerous and distinctly contraindicated.

We feel that it is imperative that the greatest care should be exercised in the preparation of the solution, using only a chemically pure drug. Only a fresh solution should be injected. The average dose varies from 7 to 10 grams, according to the estimated size of the uterus and should not be exceeded. Proper selection of cases is advisable, remembering, that its chief value lies in cases of bleeding without contractions.

CONCLUSIONS

1. Radiopaque contrast media, used for diagnostic purposes in the field of gynecology and obstetrics, is a valuable adjunct to a careful history and a careful pelvic examination; it promises to lead the way to a broader field of accurate diagnosis.

2. In gynecology, at the present time, lipiodol is the contrast fluid of choice because of its radiopacity and because by following a proper technic in selected cases, its use is practically without danger and causes little discomfort to the patient.

3. Hysterosalpingographic studies have added to our knowledge of the physiology and anatomy of the uterus and tubes.

4. A suggestion has been made for a more general standardization of technic so that roentgenograms from the various Clinics may be compared in an effort to achieve more accurate interpretation.

5. The use of radiopaque media for the visualization of the genitourinary tract during pregnancy was briefly discussed.

6. The technic of amniography has been described, and its field of usefulness as a diagnostic measure has been considered.

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COMPLICATIONS OF RADIATION TREATMENT IN GYNECOLOGY*

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THIS paper deals primarily with damage done to the bladder and intestinal tract which makes itself manifest months or years after treatment with radium and/or x-ray for gynecologic diseases.

The treatment of menstrual dysfunction and fibroids requires relatively small doses so few complications arise. An inflammation may occur immediately but it usually clears up in a short time. The infection may be carried in during the operation as believed by Corscaden[1] or it may be present already. It is characterized by pain, temperature and profuse flowing, and examination shows a sensitive uterus with tenderness and sometimes masses on the sides of the pelvis. It is rare in these days of careful diagnosis.

The treatment of cancer of the cervix with radium leads to occasional troublesome after-results. Peritonitis may be due to trauma to, or perforation of, a cancer riddled uterus where infection is already present. Rectal and bladder irritation occur soon after treatment but clear up in a few weeks as a rule. The patients complain of rectal pain and have diarrhea with bloody stools in the former case and tenesmus, frequency and burning in the latter. Treatment to relieve their symptoms is all that is required. Necrosis from overradiation is rare now that the dosage and screening are better understood. Fistulas from the bladder or rectum into the vagina are avoided for the same reason but may occur later in the course of the disease as a result of its progress. Pyometra may occur weeks or months after treatment from contraction and atresia of the cervix but dilatation allowing drainage generally relieves it. Constriction of the ureters may occur soon after treatment

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as a result of swelling, or late when the disease has progressed enough to surround them. A good many cases show a chronic vaginitis which causes adhesions between folds of the vaginal wall even months after the treatment. These are separated by the examining finger easily and cause no trouble. All these complications are well known and are avoided so far as it is possible to do so by accurate diagnosis and regulation of the dose and screening.

We have encountered complications which come on several months after the radium treatment. They are characterized by what may be called devitalization of the tissue accompanied in most cases by an acute inflammation. Therefore they usually happen in cases which have the larger amount of radiation such as cancer rather than in the menstrual dysfunction and fibroid ones.

We have had seven inflammations of the bladder appear in from two months to four years after radium treatment. The patients complain of urinary frequency and burning, accompanied in one to four weeks by tenesmus and pain on micturition. Most of them then have blood in their urine off and on, sometimes at every voiding for two or three weeks. These symptoms continue for about two months in the severe cases and then gradually decrease so that at the end of four months altogether they are well.

The cystoscopic picture in the mild cases consists of a pale center surrounded by an irregular area of edema and redness. In the severe cases there will be a central ulcer up to an inch in diameter, which may be covered with fibrin and later show more or less incrustation with salts. Around this ulcer is a wide area of intense edema with small, very red, velvety patches scattered over it. Occasionally there will be more than one ulceration. As the disease lessens the edema subsides and the ulcer slowly heals over.

This disease can be differentiated from tumor of the bladder because the distress is so much more marked than in tumor and by the great edema and intense inflammation which is not found with new growths. The bleeding from the bladder is terrifying to the patient who knows or suspects that she has been treated for cancer of the cervix. The mental relief which she experiences on being assured that it is due to inflammation and will subside in time is remarkable.

Typical histories are the following:

Case 1.—C. A., aged forty-eight, married, 4 children. January 21, 1928. A Class A squamous cancer of the cervix was treated with radium applied partly in the cervical canal and partly on the outside, screened with 0.5 mm. of silver and 1 mm. of brass for a dose of 4400 mg. hours.

April 3, 1928. Twelve hundred milligram hours with the same screening.

January 16, 1930. Well except for bladder irritation. Cystoscopy showed a shallow ulcer one inch in diameter in the middle above the interureteric line with edema of the bottom of the bladder. The pyelogram was negative.

She was cystoscoped at intervals and the condition gradually subsided so that it was healed by April 11, 1930.

An unusual case in that nearly four years elapsed between the radium treatment and the bladder ulceration is the following:

CASE 2.—F. S., aged forty-nine, married, 1 child.

February 25, 1923. A Wertheim hysterectomy was done for a Class A adenocarcinoma of the cervix.

October 14, 1925. Thirteen hundred milligram hours of radium were applied in the vagina because of a small indurated area at the top.

April 1, 1929. She began to have bladder irritation followed in two weeks by bleeding from the bladder.

April 17, 1929. Cystoscopy showed an ulceration one inch in diameter between and just above the ureteral orifices.

This gradually healed over so that she was well four months later.

Four of the others occurred in Class A cancers of the cervix treated with from 4800 to 5400 mg. hours of radium screened by 0.5 mm. of silver and 1 mm. of brass in a single dose. The seventh occurred in a diabetic who had a supracervical hysterectomy for cancer of the endometrium because a complete one could not be done on account of obesity and technical difficulties. Three months later she received a vaginal application of 3600 mg. hours of radium as a prophylactic and five months after that her bladder ulcer started. Only one of these patients was treated with x-ray also.

There appears to be little discussion of this complication in the literature. Wille[2] mentions and describes it but offers no explanation. Flaskamp[3] cites Haendly's findings in 127 autopsies. Thirty-six per cent showed bladder disease due to the tumor or radium treatment. In the latter instance it varied from catarrhal inflammation to severe exudation and ulceration always occuring on the posterior wall. Stacy[4] cites a case which showed edema and inflammation appearing four years after a treatment of 1300 mg. hours for cervical cancer and Dean[5] has followed three bladder ulcers coming on fourteen months after treatment.

It is well known that radiation may cause devitalization of tissue but it is interesting that this bladder complication should come on so long after the original treatment, even four years. It seems probable that scar forms, the blood vessels become more or less obliterated, and the bladder wall becomes vulnerable to infection at points where too much radiation has reached it. Then infection and inflammation occur at a later period, going on to ulceration in some cases. The patients do not die, so we have no pathologic description of the lesion. The cystoscopic picture after healing takes place appears to be normal.

It is also interesting that our cases of cancer of the cervix in which this complication occurred were Class A, where there was no thickness of tumor tissue to protect the bladder. It will be noted that the ulceration occurred above the interureteric line in most of them, where the bladder is attached to the cervix.

We think that accurate diagnosis of the condition is important because it may be considered as a continuation of the original disease and more radium or x-ray treatment might be used which would tend to aggravate rather than relieve it. In doubtful ulcers a piece may be removed through the cystoscope for biopsy.

Absolute prevention of this complication would appear to be difficult because of the close association of the bladder and cervix. Measures to lessen its frequency are keeping the bladder empty and packing the vagina with gauze, both of which we always do.

The treatment is expectant and symptomatic. The distress is acute enough at times to require codeine. Locally bladder irrigation and the instillation of an ounce of olive or mineral oil appear to give some relief. We have had no hemorrhage severe enough to cause anxiety.

Stricture of the rectum has occurred after radium treatment in seven of our cancer cases, six of the cervix and one with a vaginal recurrence after complete hysterectomy for adenocarcinoma of the fundus. It forms about two inches above the sphincter ani. These may be divided into two classes.

Five of them were thin strictures just admitting the tip of one finger, easily dilated and the cause of very little trouble. They were noticed in from ten to twelve months after radium treatment with from 2400 to 5400 mg. hours. Two of the patients had experienced bloody diarrhea and rectal tenesmus for a short period after the treatment. One fell in Class A, two in Class B, one in Class C, and the fifth had the recurrence after hysterectomy.

Two cases showed much more fibrosis. A Class A case received 5400 mg. hours of radium and reported five months later with a stricture which was so firm that it had to be incised and dilated under anesthesia. She showed no evidence of cancer seventeen months later so it seems probable that the stricture was inflammatory and not due to cancer. The second patient also fell in Class A. She was treated with 2700 mg. hours in 1922 after which she had rectal tenesmus for several weeks and fourteen months later she received another treatment of 4800 mg. hours for a recurrence. Sixteen months after that she had a colostomy done at another hospital for obstruction in the rectum but, since she died of heart disease with no evidence of a local recurrence nine years after her first treatment, it seems probable that this stricture was inflammatory as a result of the radium treatments rather than due to her disease.

Strictures of the rectum under these circumstances have been noted by several authorities. Jeanneney[6] says that he was the first to call attention to them and that 20 have occurred in 600 cases of cervical cancer which he has treated. Berard and Cryssel[7] found 5 in 200 cases. Jeanneney divides them into two classes which he names intrinsic and extrinsic. The former are like our first 5 cases, easily dilated, thin, soft strictures with a sharp edge which are probably due to a mild, local proctitis caused by radium irritation. The extrinsic ones are firmer, like our last 2 cases and due to inflammation in the perirectal tissues as well as to a proctitis. Berard says that those he has seen are of the latter type because he noted infiltration around the rectum before treatment and believes that there is a cellulitis first which the radiation converts into a sclero-inflammatory perirectal stenosis. It may be that they are due to the replacement of cancer tissue by scar tissue. We think the last is unlikely because when cancer from the cervix encircles the rectum

it does so higher up, in the region of the uterosacral and broad ligaments. This might have been true in our case which required a colostomy but it seems improbable because when the disease is as advanced as that it is unlikely that an apparent cure will result. We believe our cases correspond with Jeanneney's and that the severe, dense stenoses are due to a preceding cellulitis which forms a dense, contracting scar with the added radium irritation.

The treatment is dilatation which is very satisfactory in the intrinsic cases. Berard says that diathermy helps by softening the structures, making dilatation easier and more permanent in the extrinsic ones.

Four distressing complications have occurred higher up in the intestine. Two were strictures of the sigmoid and one a necrosis of the ileum in patients with cancer of the cervix and one an inflammation in the sigmoid adherent to the uterus in a case of menstrual dysfunction.

CASE 3.—A. W., aged fifty-one, widow, 1 child.

December 19, 1927. She was treated for a Class B inverting adenocarcinoma of the cervix with 4800 mg. hours of radium screened with 0.5 mm. of silver and 1 mm. of brass. One month later she complained of pain when her bowels moved.

April 23, 1928. She was having many small movements with much gas and pain. The x-ray examination showed a constriction at the rectosigmoid junction.

May 5, 1928. A laparotomy was done and the sigmoid was found adherent to the back of the uterus with many adhesions between loops of small intestine in the pelvis and marked edema of all the pelvic contents. It would have been necessary to have separated these adhesions with a good chance of doing damage resulting in peritonitis so it was deemed wisest to do a colostomy. She made a good convalescence.

November 30, 1928. The pelvis was negative. An x-ray showed the stricture as before.

April 23, 1929. She began to have some movements through the anus but refused to have anything further done.

January 8, 1930. She had been comfortable, her bowels moving mostly through the anus, some through the colostomy. X-ray showed that there was much less obstruction.

December 4, 1930. Her bowels had moved normally every day but the colostomy had not closed. She refused to have it closed by operation.

January 13, 1931. She began to have severe headaches, which were finally diagnosed as due to a metastasis in the brain, and died soon after. There was no apparent local recurrence.

It is obvious that this complication was due to the sigmoid being adherent to the back of the uterus with damage from the radium as a result. There was no history of an antecedent inflammation or operation to cause the adhesion and no way to diagnose it beforehand. It is interesting that the stricture should have relaxed enough to allow normal bowel movements. The colostomy was done with some difficulty because the patient was fat and the mesentery of the colon was short, in spite of freeing the outer sheet of peritoneum, so a bridge of skin was placed under the loop of bowel to keep it from retracting. That is probably what prevented it from closing entirely when the stricture opened.

CASE 4.—E. D., aged fifty, married, 3 children.

June 4, 1930. She received 4800 mg. hours of radium with the same screening for a Class C inverting squamous carcinoma of the cervix.

December 10, 1930. She had been seen at regular intervals and appeared well. Deep x-ray treatment was started.

June 5, 1931. She had had x-ray treatment as follows:

December 29, 1930. Using 200 K. V., 40 cm. distance ¼ mm. of copper and 1 mm. of aluminum, 5 mm. of current and thirty minutes anteriorly over the lower abdomen through a 20 by 20 cm. Port.

January 6, 1931. Same dosage, thirty minutes, posteriorly.

January 23, 1931. Same dosage, thirty minutes, anteriorly.

February 7, 1931. Same dosage, thirty minutes, posteriorly.

March 20, 1931. Same dosage, thirty minutes, anteriorly.

April 14, 1931. Same dosage, thirty minutes, posteriorly.

She felt well. The local examination was negative.

July 14, 1931. She was operated upon by Dr. H. B. Loder for acute intestinal obstruction which was due to a stricture about five inches above the rectosigmoid junction. This part of the intestine lay in the pelvis behind her cervix. Six inches were resected and an end to end anastomosis done from which she made a good recovery and has been well since.

We were allowed to see the specimen and microscopic slides through the kindness of Dr. S. C. Dalrymple, pathologist at the Newton Hospital, Newton, Massachusetts. The entire thickness of the intestinal wall contained an inflammatory infiltration and there was marked edema of the submucosa with loss of the mucosa in the region of the stricture. The muscle fibers and their nuclei were fairly normal. The blood vessels throughout the section were apparently normal.

In this case the sigmoid was not adherent but it was redundant, so that it lay in the pelvis within the radiation area. An intestinal x-ray before treatment might have shown it, but it would seem too meticulous to do that in every case that we see in order to prevent such a complication. The patient must have had rather an acute inflammatory stage without enough symptoms to trouble her, because she complained of none until the actual obstruction took place, and the pathologic examination showed a well healed scar. It is also possible that the deep x-ray therapy might have played some part by supplying an overdose of radiation; but six months had elapsed since the radium application, and therefore we do not believe it is probable.

Case 6.—E. H., aged fifty-five, widow, 4 children.

January 2, 1931. She received 4800 mg. hours of radium with the same screening for a Class C carcinoma of the cervix.

January 30, 1931. She had had some bloody diarrhea and rectal tenesmus.

March 13, 1931. She was free of symptoms and the examination was negative.

April 21, 1931. She complained of mild cramplike pain in the region of the pubes. Examination was negative.

April 26, 1931. For forty-eight hours she had had more pain accompanied by vomiting and showed a rigid abdomen, temperature and white count. Operation revealed free fluid and fresh adhesions between coils of intestine in the pelvis but the uterus, tubes, ovaries, and appendix were negative. A loop of ileum ten inches long was lying in the pelvis, its distal end two inches from the cecum. It showed a red, thickened wall with green necrotic areas. Its caliber gradually decreased from both ends towards the middle. There was no twist, old adhesion or other mechanical cause for the condition. This was resected, and an end to end anastomosis done, with an ileostomy six inches above. She died in two days with no distention, nausea or vomiting, apparently from an overwhelming infection.

This loop of small intestine was not adherent but must have remained in the pelvis long enough to have been affected by the radium. The length of the piece and the extent of the devitalization are extraordinary.

The pathologic findings were as follows:

Macroscopic Examination.—Specimen consisted of 22 cm. of ileum. The wall was edematous and covered with exudate and fresh adhesions. At the center of the resected gut was a scarred constriction obstructing the lumen of the bowel. The proximal portion of the bowel was somewhat dilated. Section was taken from point of obstruction, also one other section was taken. There was no gross evidence of malignancy.

Microscopic Examination.—There was a narrow section of mesentery which contained a marked inflammatory infiltration and normal appearing blood vessels. The serosa was edematous and infiltrated with leucocytes. The muscular layers stained poorly. The muscle bundles could be differentiated but the nuclei had disappeared and the general picture was of a beginning hyaline degeneration. The submucosa was markedly inflamed and edematous. The blood vessels appeared to be normal in number and size. Throughout the section no evidence of obliterating endarteritis was found. The mucosa was lacking, the inner edge consisting of connective tissue covered with exudate.

A section from the end of the piece of bowel showed the normal structure of the wall but there was an inflammatory exudate throughout the layers.

Diagnosis.—Acute inflammation, necrosis, hyaline degeneration.

The examination of these two specimens showed no evidence of obliterating endarteritis but did show a good deal of scar and, in one, definite changes in the muscle layers. We feel that endarteritis does not play as important a part as has been supposed in devitalization of tissue by radiation but that the effect is a direct one on the tissue cells. Further since the mucosa was completely destroyed in both of these, epithelial tissue is more vulnerable than others, which is what one would expect from our treatment of cancer.

CASE 7.—M. H., aged forty-eight, married, no children. Bilateral salpingectomy, 1923.

October 7, 1930. She had had profuse menstruation for one year.

Ether examination showed a small fibroid in the left horn of the uterus and the rush diagnosis on the endometrium was endometrial dysplasia. We debated, in view of her previous operation, as to whether to treat her by radium or operation. Since the operation had been seven years before, during which time she had had no symptoms and all examinations had given no sign of tenderness or other abnormality, radium was decided on and 100 mg. screened with 0.5 mm. of silver and 1 mm. of brass was applied in the uterine cavity for twelve hours.

November 28, 1930. For four days she had had a heavy feeling in her pelvis and vomited a few times. This day she complained of a twisting feeling at the navel, radiating all over the abdomen, and vomiting. Examination revealed only tenderness through the pelvis. She remained in the hospital two weeks and was apparently well on leaving.

March 9, 1932. The patient had had no catamenia since her treatment sixteen months before. She complained of having had occasional attacks of pain and discomfort in the rectum. Five days before admission she felt as if something broke in her lower abdomen and began to have fever and discharge. Examination showed induration in the pelvis but no masses.

She was no better at the end of three weeks so operation was decided on. This revealed a loop of sigmoid densely adherent to the back of the fundus of the uterus with an abscess containing two ounces of pus between them. The intestine was otherwise normal. No perforation could be made out and the raw surface was sutured over. A hysterectomy was done because there was so much induration in the parametria. The wound was closed with drainage and she made a good convalescence.

Here again the cause of the complication is evident. The mistake was in treating a patient, who had had a previous pelvic operation, with radium. In order to prevent all such incidents one would have to adhere strictly to the dictum that no

patient who has a history of any previous pelvic inflammation or operation should be treated with radium, regardless of how distant the occurrence was or how free of symptoms the patient has been.

In two of these four cases the intestine was held in the radiation area by adhesions and in the other two the loops must have stayed in the area long enough to have been damaged. We feel that in view of the few cases reported that some of these intestinal complications are not diagnosed. It may be that only a small area is affected in many and that it heals without causing much trouble. Our second case certainly had no symptoms of note before the acute attack. The third one had some pain five days before the emergency operation but there were not enough objective signs to make one suspect that such a serious condition existed.

We can find very little in the American literature about such intestinal complications. Lynch[8] speaks of a patient who "died, two years after treatment, of bowel obstruction of cancerous origin or possibly as a result of radium given when our experience was incomplete." It might well have been one similar to ours. Stacy[4] states that if narrowing of the rectum is noticed before treatment the patient should be kept under observation for two or three weeks after treatment because edema may complete the obstruction and a colostomy be necessary. We have seen no cases like that.

A great deal of experimental work with animals has been done on the effect of x-ray and radium on the gastrointestinal tract. The articles have been collected and reviewed by Desjardins.[9] He concludes that the results of the two kinds of radiation are the same. The immediate effect is an increase in tone and spasticity of the intestinal wall. Then a mucoid and vacuolar degeneration of the epithelium takes place followed by desquamation. A large amount of bloody mucus is found in the bowel. The change may go on to inflammatory infiltration, hemorrhage into the tissue and ulceration. Later there is a formation of connective tissue with stricture and shortening of the intestine. Large numbers of colon bacilli are found in and on the ulcerations but evidence so far is contradictory as to whether or not the bacteria make their way into the blood stream to produce septicemia. Any one application of radiation may not be dangerous but when several are given from various angles they may converge and focus at one place to cause an overdosage with destructive results.

Flaskamp[3] has looked over the world literature up to 1930 and written a complete account of damage done by radium or x-ray in all parts of the body. The section dealing with gynecology cites cases treated with x-ray and/or radium which showed damage to the intestine varying from catarrhal inflammation to necrosis and ulceration. Many of them were due to overdosage. The interesting point, however, is that the damage took place in the more stationary parts of the intestinal tract such as the rectum, sigmoid, and cecum. When small intestine was affected it was usually more or less fixed by adhesions which had formed before the treatment was applied. For instance he cites Eckelt's experience with 21 cases of cancer of the uterus treated by x-ray. Seventeen of them had diarrhea, 8 of these died, and 4 showed ulceration of the intestine where it was adherent beneath the area of treatment. Haendly[5] has done 127 autopsies on patients treated with x-ray and/or radium. In 31 cases (24 per cent) there were evidences of damage to the intestine such as ulceration, stenosis, and necrosis. All parts of the intestinal

tract were affected but in general x-ray hurt the descending colon and radium the rectum more generally. The cecum and lower ileum showed the effects not infrequently and the transverse colon three times. Strauss[3] is inclined to doubt that this complication occurs as often as Haendly states, but he believes it would be noticed oftener if we were on the lookout for it. The symptoms are not regarded seriously enough and the mild cases heal without being diagnosed.

Knowing that such serious complications may occur we are concerned with the prevention of them so far as possible. The dosage of radiation and the screening should be considered most of all. If one is dealing with a Class A cancer of the cervix or cancer in the cervix after supracervical hysterectomy the chance of radiating near-by organs is greater than usual and one should vary the treatment accordingly. Now that deep x-ray therapy is used as well as radium we think the chance of overdosage will be greater than it has been and that undoubtedly more of these late complications are going to occur and be diagnosed if we are on the lookout for them. Flaskamp believes that adhesions may be found beforehand by causing pneumoperitoneum and taking an x-ray. If found they may be treated by operation before the radiation is applied. We think that adhesions might well form again immediately. Therefore unless there is a good reason for feeling that there may be some present, such as a history of inflammation or operation, one had better take the slight chance which there is of doing harm in going ahead with radiation. All agree that the intestinal tract should be empty before treatment and most that the bladder should be on constant drainage or frequently emptied during it. No radiation should be given while there is any barium in the intestinal tract because of the danger of necrosis from secondary rays. It might be well to place the patient in the Trendelenburg position during treatment with radium, but it would be rather a strain on her to make it constant for twenty-four hours or more. We hardly think that a lesser degree of elevation would get the small intestine out of the pelvis. She should be told to change her position often as that would tend to move the abdominal contents to some extent. Lying in the Sim's position at intervals would allow the pelvis to empty.

The cases that we have cited were treated at the Free Hospital for Women and in my private practice. The total numbers treated with radiation were as follows:

	F. H. W.	F. A. P.	TOTAL
Cancer of the cervix	382	43	425
Leiomyoma of the uterus	42	28	70
Menstrual dysfunction	422	74	496

The patients at the Free Hospital for Women were treated by Dr. William P. Graves, Dr. George V. Smith, and myself.

We think we may grant that stricture of the rectum and inflammation of the bladder are unavoidable. That is, they will occur occasionally. The case of a fibroid with the sigmoid adherent to the fundus as a result of a previous operation should not have been treated with radium. We

feel that the other three intestinal complications were unavoidable accidents bound to happen when one is dealing with large doses of radium and x-ray in the treatment of cancer.

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TWELVE YEARS' EXPERIENCE WITH UTEROTUBAL INSUFFLATION; DIAGNOSTIC AND THERAPEUTIC*

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INTRODUCTION

THE specific object for which uterotubal insufflation was originally devised was to replace exploratory laparotomy in the diagnosis of the tubal cause of sterility. It was felt that once the integrity of the female genital tract could be demonstrated without resorting to an operative procedure, we would be able to avoid doing needless operations upon the uterus, especially upon the cervix. We should, thus, be able to treat sterility more intelligently.

Intensive study of human sterility during the last twelve years has brought out many causative factors which heretofore had not been adequately estimated. The last decade has witnessed a steadily growing interest in the functional (inner secretory), chemical, and serologic aspects of human reproduction. In the light of this newer work the patient's constitution has been reinterpreted.

After a little more than twelve years' experience with uterotubal insufflation it has become possible to estimate the importance of nonpatent tubes in any sterile mating. The purpose of this paper is to present the findings in a fairly large series of sterile women especially from the viewpoint of the tubal factor.

Obviously, the determination of the tubal status by no means exhausts the investigation of sterility. Due consideration was given to all other important etiologic factors. But it was necessary to establish as fully as possible the diagnostic value of uterotubal insufflation. Only in this way could it properly be compared to other methods.

A by-product of the investigation of the diagnostic aspects of uterotubal insufflation was its therapeutic value. The determination of the therapeutic value remains subject to greater differences of opinion and interpretation than is the diagnostic value of insufflation.

Another phase of the work has been the resumption of the use of

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opaque solutions which Cary[3] and I[14] employed independently in 1913 and 1914 but which were abandoned because of certain disadvantages. The earlier solutions, collargol, sodium bromide, sodium iodide, and thorium have been replaced by lipiodol and other iodized oils, which are less irritant and more radiopaque.

Opaque solutions with the aid of x-rays had been proposed for the localization of tubal obstructions, but increasing experience with uterotubal insufflation has made such examinations unnecessary except in a few special instances. During the period of investigation lipiodol has served the purpose of checking the findings and interpretations in certain details, and more particularly in the study of tubal sphincters. In my work lipiodol is now reserved for a relatively small group of cases where the fallopian tubes prove to be closed by the gas method or to be the seat of high grade obliterating tubal strictures.

Time does not permit full reference to an extensive literature on tubal insufflation with numerous excellent reports by workers here and abroad, to whom a large measure of the progress that has been made is due. These reports are included in a monograph now in preparation which, it is hoped, will be forthcoming in the near future.

INDICATIONS

Sellheim,[21] in writing on seven years of tubal insufflation, considers "the examination of the patency of the tubes just as important as the determination of the accessibility and functional fitness of the vagina and uterus which are always investigated. The procedure of the examination of the tubal functions has been made so free from danger that a thorough gynecologic examination should almost be considered incomplete if an investigation of the functional fitness of the tubes is omitted. The physician should be interested to get a clear picture of this vital question."

The cardinal indication for uterotubal insufflation is to determine the patency of the fallopian tubes. The method has been found useful:

1. In deciding upon the advisability of an operation to relieve sterility.
2. As a postoperative measure to test and maintain the patency of the newly formed stoma (salpingostomy, salpingolysis, and tubal reimplantations into the uterus).
3. To check the results of a tubal sterilization operation.
4. To determine the secondary effect upon the tubes of induced abortions, uterine retrodisplacements and appendicitis.
5. To determine the condition of a residual tube after tubal pregnancy.
6. To study the physiology of the tubes, especially in such conditions as functional amenorrhea during the reproductive period, during the menopause and following x-ray castration.
7. To determine the tubal status before prescribing contraceptive measures in suitable cases.
8. As treatment for dysmenorrhea.
9. To produce a pneumoperitoneum as an aid in the diagnosis of obscure abdominal lesions.

10. Its application has been extended by veterinarians to valuable breeding animals where sterility was traceable to abnormalities of tubal patency.

Exceptional Indications.—A few patients whose husbands have been found azoospermic have nevertheless wanted to know the condition of their tubes. A few patients who were married only a short time also sought aid early because a sterile sister may have warned them against treatment too long delayed. Advanced age or the desire to settle an estate have been other reasons.

Contraindications.—Increasing experience has justified these conclusions as to when the test is contraindicated. They are:

1. *Inflammations of the Genital Tract.*—The test should not be done in the presence of acute or subacute inflammations, whether they are in the nature of an endocervicitis, colpitis, or salpingitis. In order to rule out the presence of inflammatory processes, white blood counts, vaginal and cervical smears, and sedimentation tests are employed. As the indication for the test is never imperative any questionable conditions should be observed over an adequate period, so that the insufflation will be performed at the most suitable time.

2. *Menstruation and the Premenstrual Phase.*—The theoretical possibility of endometrial dislocation and embolism formation precludes the use of the test at these cyclical phases. Because of the further theoretical possibility that insufflation might interfere with an already existing pregnancy, it is not advisable to practice it in the premenstrual period. Furthermore, the mucosal congestion, swelling and spasm incidental to menstruation and the premenstrual period may make higher pressures necessary to permit the gas to pass the uterotubal junction and so lead to false conclusions.

3. *Abnormal Bleeding From the Genital Tract.*—Experimental and clinical observations have shown that this condition may favor emboli. Theoretically too, infections are more prone to occur at this time.

4. *Pregnancy.*—Except for its scientific value in isolated cases, there would seem to be no point in performing a test for tubal patency when pregnancy exists. However, should the test be performed accidentally during this period, it is not likely that any harm will result. Thus, Peterson and Cron[13] insufflated two patients during early pregnancy through mistaken diagnosis. Both patients were delivered of normal children. Titus[22] and Moench[11] have had similar experiences. No untoward results were encountered in ten patients of my series who were insufflated during pregnancy.

5. *Severe Constitutional Diseases.*—As severe constitutional diseases such as cardiovascular disease, severe diabetes and active pulmonary tuberculosis contraindicate pregnancy, tubal insufflation is out of place.

6. *Neurosis.*—Patients with a frankly neuropathic disposition do not stand the test well and in such cases I have not recommended its use.

COMPLICATIONS

In the present series of 3600 insufflations there were no serious complications. Twenty-seven patients felt momentarily faint. In 7 instances the patient fainted and was quickly restored. Darkness during the fluoroscopic examination appears to be an exciting cause. To avoid syncopal attacks, patients have been questioned as to whether they faint easily. Their answer has proved useful in avoiding this not very serious complication. Two patients in whom an epileptic tendency had been overlooked had an attack brought on by the test.

Staining during the performance of the test or shortly after is not infrequent. This is of no special importance. In my earlier cases, when the method was tried out under varying conditions in order to determine its safety, there were three instances of mild pelvic irritation, which quickly subsided with rest in bed. Scrupulous attention to indications and contraindications as set forth above, have prevented untoward accidents and sequelae in later experience and the last 2800 insufflations have been entirely without unpleasant symptoms.

TIME OF ELECTION FOR INSUFFLATION

The postmenstrual phase, from the fourth to the seventh day following the cessation of the last regular period, has been found the interval of choice for performing insufflations. Interference with a possible pregnancy is thus avoided.

OFFICE PROCEDURE

Insufflation has been carried out exclusively as office routine. The patients were always able to return home soon afterward and to perform their usual duties. No preparation, save possibly a good night's rest, is required in the majority of cases. An apprehensive patient may need an anodyne but this is rare. In no case was it necessary to resort to an anesthetic for the test.

Apparatus.—A very decided improvement has been made in the apparatus used for the insufflation. The present apparatus combines quantimetric, manometric and kymographic parts, and assures a uniform pressure rate of flow within given limits, i. e., twenty to thirty seconds to inject 30 c.c. of carbon dioxide. This is of the greatest importance. Somewhat slower rates are also serviceable but a more rapid flow is not to be recommended. If the gas is introduced too rapidly, the pressure will be unduly high and lead to wrong interpretations. This is often the case when the syringe and bulb types of apparatus are employed.

With such "simplified" apparatus, important points such as the degree of patency, the presence of peritubal adhesions and uterotubal spasm are missed. By the addition of the kymograph in 1925, a number of physiologic and pathologic data have been obtained that will be briefly detailed later. As Mikulicz-Radecki[10] has said, we are just beginning to realize its scientific value. By the exclusive use of carbon dioxide gas, which is rapidly absorbed, discomfort and shoulder pains have been reduced to a minimum. Large quantities of carbon dioxide gas, necessary to produce a subphrenic pneumoperitoneum for pelvic diagnosis, are rapidly absorbed.

Sounding the Uterus.—The uterine sound has not been used as a routine. As a rule, palpation of the uterus and inspection of the cervix enable us to judge the length of the uterine cavity, its direction and whether or not the cannula may be easily introduced.

If a uterine sound is used just before insufflation is performed, it should be handled with the greatest gentleness as it may be followed by bleeding. The uterine cannula should be introduced to just beyond the internal os engaging the external os by its rubber acorn, to avoid pushing the metallic tip into the myometrium or possibly perforating the uterus. These are accidents which happen rarely but should be borne in mind. True cervical stenosis has been discovered in a certain number of instances by the inability to introduce the cannula into the uterine cavity. This condition is not without etiologic importance and must be corrected before the condition of the tubes is tested.

Findings With the Aid of the Kymograph.—The kymograph enables us to obtain a permanent and accurate record of the tubal status. The characteristic findings of normal patency, of nonpatency and spasm have been described elsewhere; they will not be detailed here. The findings in the case of strictures and peritubal adhesions deserve special consideration as they point to the difference between insufflation and lipiodol injection.

Tubal Strictures and Peritubal Adhesions.—When the tubes are strictured, the pressure rises in a curve, the descent is more gradual and there is apt to be complete absence of typical oscillations. The initial rise of pressure is usually well over 100 mm. Hg, more often between 150 and 200 mm. Hg. In the relatively mild strictures due to circumscribed adhesions there may be noted atypical oscillations which are very shallow and arrythmic. When the tubes are bound down lightly as by filmy adhesions which do not distort, there may be only the slightest variation from the normal.

If the tubes are bound down by firm adhesions on all sides so that their motion is impaired, the rythmic contractions are not seen although the pressure levels may not not exceed the normal. Experimental work has shown that isthmic stenosis blocks tubal peristalsis and interferes with rythmic contractions more markedly than ampullary or fimbrial stenosis.

Occasionally, one encounters a case where the fluctuations are slight and the gas is also regurgitated. If the gas has succeeded in entering the peritoneal cavity, a rise of pressure will be produced when the patient bears down, coughs or sneezes. When the kymograph is not available, it is possible to plot a curve by noting the rise and drop of the manometer. The curve thus charted is of aid in distinguishing between normal patency, peritubal adhesions and uterotubal spasm. When hysterosalpingography alone is employed it is not possible to diagnose these conditions, except in rare instances.

Vaginal Palpation.—Immediately after insufflation vaginal palpation may demonstrate a distended tube which will be empty a few minutes later. In the absence of regurgitation this would point to the presence of spasm or some stricture at the fimbriated end which has been overcome. Occasionally, one will palpate a hydrosalpinx which may hold as much as 150 c.c. of gas. Hence, if the amount of gas injected is comparatively small as when the syringe and bulb types of apparatus are used, one may be led to false conclusions. Occasionally, emphysema is encountered which disappears without causing further trouble.

Shoulder Pains.—Shoulder pains occur in the presence of gas under the diaphragm. The amount of gas allowed to enter the peritoneal cavity and to rise to the subphrenic space, in relation to the particular patient's weight and abdominal and chest measurements determines the intensity of the shoulder pains. A thin individual whose waistline is narrow requires less gas for the production of a well marked subphrenic pneumoperitoneum than an obese person. In general when a fluoroscope is not at hand at least 100 c.c. of carbon dioxide gas should be used. The patient should rise as soon as possible to note whether shoulder pains occur. The knee chest or recumbent position relieves them at once. Prolonged shoulder pains are usually due to failure to displace the air in the rubber tubing by carbon dioxide gas before introducing the cannula into the uterus.

The Fluoroscope.—The fluoroscope is an important objective aid in the diagnosis of tubal patency. The depth of the subphrenic pneumoperitoneum, other things being equal, is a practical guide as to the type of patency. In strictured tubes the gas bubbles, forced through the narrow apertures, are smaller and some of the gas is lost by regurgitation.

In a few instances, part or all of the gas is caught by adhesions in the pelvis surrounding the tubes, or it is prevented from rising to the diaphragm by subphrenic

adhesions. In such an event, shoulder pains are absent. Delayed shoulder pains are due to the gas being entrapped in the pelvis and gradually escaping upward along the abdominal gutters to the diaphragm.

In obese individuals, occasionally, fluoroscopy will be negative although the kymograph has already given proof that tubal patency exists.

Subphrenic pneumoperitoneum may appear on either side irrespective of the side of patency. The gastric vesicle may sometimes be misleading. If there is any doubt the patient should be instructed to lie on the left side; pressure is then exerted over the right chest after which the gas is seen under the right diaphragm. Here it is unmistakable. The pneumoperitoneum is apt to persist longer on the right than on the left side. The contractions of the stomach appear to further the escape and wider distribution of the gas.

Localization of the Site of Tubal Obstructions.—In the presence of normal patency patients do not feel the slightest pain referable to the tubes themselves. They may complain of a sense of discomfort in the suprasymphyseal area, referable to the uterus which is momentarily distended, and lasting for the brief period before the gas passes through the uterotubal junction. Complaint of slight discomfort on one or the other side of the abdomen is only occasionally met in normal tubes.

In the presence of tubal stenosis, peritubal adhesions and nonpatency there is, as a rule, some pain referable to the tube affected. Pain reactions have been found to begin at 120 to 150 mm. Hg in closed or strictured tubes. Where adhesions exist, their stretching may cause pain at a much lower level. The obstruction in some cases is bilateral, in some unilateral. The location is symmetrical or asymmetrical.

Distention pain which does not radiate and is referred to the mid-line in the suprasymphyseal area points to an obstruction at the uterotubal junctions. Pain of the same character but also located somewhat laterally indicates isthmical obstruction. Pain radiating well out to the sides indicates an obstruction at the ampulla. The nearer to the fimbriae the site of obstruction is situated, the more marked is the pain. The pain may radiate to the lumbar region and sometimes down one thigh or the other. This pain reaction is stressed because of its diagnostic significance, but it is tolerated by practically all patients and lasts only for the brief time required for the insufflation. It must not be forgotten that pain is also incidental to lipiodol injection. From observation in my cases, this sensory reaction is more prolonged when lipiodol is used than during insufflation.

When only one tube is normal, the kymograph registers normal patency, but abdominal auscultation and careful notation of the pain reaction will point to the side of the obstructed tube. Auscultation, however, is not absolutely diagnostic as the sound elicited may be transmitted to the side of the nonpatent tube. The purring, hissing or gurgling sound is, as a rule, more audible on the side of the patent tube.

In normal patency the tubal bruit is found to be intermittent, the silent phase corresponding to the rise in pressure and the contraction phase of the tube. In adherent and strictured tubes, this bruit is more constant, the typical intermissions being absent. In retroflexed uteri when the tubes are prolapsed, it may be impossible to distinguish between the tubes because of the close proximity of their fimbriated ends. Another source of confusion may be the presence of a hydrosalpinx, having a capacity of 150 c.c. or more. Upon auscultation the sound of the gas passing into such a tube must not be mistaken for bubbles percolating through the fimbriated end. In such cases and others the kymograph and the fluoroscope are of particular help in establishing an accurate diagnosis. And so likewise is vaginal palpation before and after insufflation.

The data obtained at insufflation were analyzed and checked by: (1) experiments upon surviving extirpated uteri and tubes and upon these

organs removed from the sow, (2) laparotomy observations, and (3) findings after lipiodol injections. The experimental side has recently been gone into in detail and will be published in the near future.

LAPAROTOMY FINDINGS

Invaluable information concerning the interpretation of insufflation findings was derived from 186 cases in which the tubes could be studied in relation to laparotomy findings. In the patients not operated upon by myself, data concerning the operative findings were obtained from reliable sources.

1. Normal tubal patency	was checked by laparotomy in 28 cases.
2. Tubal nonpatency	was checked by laparotomy in 20 cases.
3. Peritubal adhesions	was checked by laparotomy in 22 cases.
4. Tubal stenosis	was checked by laparotomy in 12 cases.
5. Status of a residual tube	was checked by laparotomy in 72 cases.
6. Insufflation findings before and after tubal operations	was checked by laparotomy in 25 cases.
7. Status after tubal ligation	was checked by laparotomy in 7 cases.

LIPIODOL EXAMINATIONS

In the present series, uterotubal lipiodol examinations were performed in 132 cases as a further check upon insufflation. In 92 cases the insufflation findings of nonpatency, and in 23 cases the diagnosis of high grade strictures, were confirmed. In 9 cases of tubal obstruction the lipiodol succeeded in passing the fimbriated end at higher pressures than were employed at insufflation. On the other hand, in 8 cases the tubes were patent to insufflation but not to lipiodol. Intrauterine lipiodol injections have been limited in my work to those cases where insufflation has shown the presence of closed tubes or high grade strictures.

In the 132 cases examined by lipiodol, 6 patients had a peritoneal inflammation of mild grade. Three others developed pelvic abscesses requiring operative intervention. In contrast to these complications not one accident was encountered in this series of 132 patients as a result of the insufflation, although the test was performed at least twice in 123 and as many as seven times in some patients of this control group.

ANALYSIS OF THE TUBAL STATUS

In 81 patients of the total series, a diagnosis of the tubal status was not made because only one test was done and the data obtained were

TABLE I. TUBAL STATUS OF 2192 STERILITY PATIENTS

	NUMBER OF PATIENTS	PERCENTAGE
Normal patency	947	43.20
Nonpatency	572	26.10
Spasm-normal patency	103	4.70
Peritubal adhesions and tubal strictures	570	26.00
Total	2192	100.00

insufficient. Failure to diagnose was due largely to stenosis of the cervical canal; the cannula in these cases, had not succeeded in completely passing the internal cervical os. In some apprehensive patients the test could not be completed. A few out-of-town patients did not return for further study.

PROGNOSTIC IMPORTANCE OF UTEROTUBAL INSUFFLATION

In general, all other factors being equal, patients with normal tubal patency and function may be offered a good prognosis. The prognosis should be guarded in patients with stenosed and adherent tubes. Repeated insufflations not infrequently improve the status and accomplish a cure. When the tubes are repeatedly found obstructed at 200 mm. Hg, the prognosis must remain poor unless further improvement takes place as a result of insufflation.

ANALYSIS OF THE TUBAL STATUS IN RELATION TO SPECIAL FACTORS

Analysis was made of the tubal status following induced abortions and appendicitis, and of the residual tube following extrauterine pregnancy. Further analysis was also made of the condition of the tubes in association with uterine fibroids and uterine retrodisplacements.

TABLE II. TUBAL STATUS IN RELATION TO SPECIAL FACTORS

	NORMAL PATENCY		PARTIAL OBSTRUCTION		NONPATENCY	
		PER CENT		PER CENT		PER CENT
Induced abortions	72 cases	39.78	13 cases	7.18	96 cases	53.04
Appendicitis	121 cases	39.54	98 cases	32.03	87 cases	28.43
Fibroids	37 cases	42.04	34 cases	38.64	17 cases	19.32
Residual tube (tubal pregnancy)	13 cases	18.06	28 cases	38.88	31 cases	43.06
Retroflexions	94 cases	34.82	86 cases	31.85	90 cases	33.33

THE INFLUENCE OF OVARIAN HORMONAL FUNCTION ON THE FALLOPIAN TUBES

Clinical tubal insufflation was employed in order to determine a possible secondary effect upon tubal contractions during different phases of the ovarian cycle. Fifty-nine women were insufflated on the tenth to the sixteenth day of the cycle, counting from the first day of the preceding menses. The type of contractions was then compared to that in an equal number of patients who were insufflated from the seventh to the tenth day of the cycle and an equal number from the sixteenth to the twenty-eighth day of the cycle.

The uterotubal tonicity, as measured by the initial rise of pressure at which the gas passes the uterine junction into the tubes, was decidedly higher in the group insufflated on the tenth to the sixteenth day of the cycle, and the rate and depth of tubal contractions were also greater.

In 120 cases of amenorrhea there was a striking decrease in uterotubal tonicity, in the rate of the contractions and in their amplitude. These patients also exhibited a contraction fatigability manifested by a decrease in the rate and depth after a minute or two. In 5 cases of ovarian hypofunction, the tubes were insufflated before and after stimulating doses of x-ray and radium. After such "ovarian stimulation" there was an increase in the contraction rate in all five and an increase in the amplitude of the contractions in four.

Seven patients were insufflated during the menopause. In three instances the initial rise of pressure was below 50 mm. Hg. There were no tubal contractions in three instances; in four the contractions were infrequent and rarely reached above 5 mm. Hg.

The effect of castrating doses of x-ray irradiation of the ovaries, in relation to tubal function, was studied in 33 women. These were patients from the gynecologic service at Mount Sinai Hospital who were treated by the x-ray department in order to produce a therapeutic abortion for various vital indications. Twenty-two or 66.6 per cent had initial pressure rises under 50 mm. Hg, as compared to 13 per cent in untreated patients with normal periods. The contraction rate was not decreased for the first minute or two, after which however, the tubes become fatigued, exhibiting infrequent and shallow fluctuations.

THERAPEUTIC VALUE OF INSUFFLATION IN STERILITY

The therapeutic value of insufflation has been demonstrated in two ways: (1) by the improved status of the tubes as seen at once during the first application, or in subsequent tests; (2) by pregnancy following closely upon insufflation.

In the present series, 44 patients with peritubal adhesions showed improvement at a subsequent test while 43 others eventually showed normal patency and function. Sixty-three patients with tubal stenosis and 22 with uterotubal spasm showed improvement after repeated insufflations. The effect of repeated insufflations was most striking, however, in 116 cases which showed varying degrees of tubal patency after a negative initial test. In 41 instances improvement was noted on the kymograph during a first examination, the insufflation being prolonged for several minutes. Repeated tests were usually done when the tubes were found obstructed. One patient had twelve tests.

The therapeutic effect of the method is best judged by the pregnancies that have occurred promptly or very soon after insufflation, particularly in patients who were sterile for more than five years and in whom tubal patency and function were found to be impaired.

There have been 764 pregnancies collected from the literature and personal communications, all of which have been attributed directly to insufflation.* Undoubtedly, a greater number have not been reported.

*An analysis of statistical reports of larger and smaller series, kindly forwarded to me, will be given in the future.

Among those who have reported pregnancies for which insufflation may be credited are: Anspach,[1] 18 cases; Campbell,[2] 14 cases; Ferguson[4] and Graff,[5] 38 cases each; Greenhill,[6] 52 cases; Mandelstamm,[7] 61 cases; Mayer,[8] 98 cases; Meaker,[9] 30 cases; Mombach,[12] 16 cases.

In my own series 398 women or 17.50 per cent of those who were insufflated for sterility became gravid. If we consider only the 1620 cases in which some degree of patency was demonstrated, the percentage is 24.57 per cent.

TABLE III. INCIDENCE OF PREGNANCY RELATIVE TO TUBAL STATUS

	TOTAL CASES	NUMBER PREGNANT	PERCENTAGE
Normal patency	947	254	26.82
Spasm-normal patency	103	21	20.38
Strictured and adherent tubes	570	123	21.58

The therapeutic results were particularly noteworthy in the 570 cases of sterility in which there was some organic interference in tubal patency, i. e., adhesions or strictures. One hundred and twenty-three or 21.58 per cent of this group became gravid.

At least one out of five patients coming for the relief of sterility, and whose tubes were not permanently sealed, became pregnant after insufflation. It may be noted in this connection that no systematic questionnaire had been sent out to these patients, the reports being voluntary. It is likely that the percentage of pregnancies would be higher if all data were available.

There were 269 patients or 67.59 per cent of the successful cases who became gravid during the first six months after the test. There were 168 or 42.21 per cent of the gravidities that took place within two months of the test. There were 111 or 27.89 per cent that became gravid within a month after the test. This short interval would appear to be a fair criterion of the therapeutic effect of insufflation. The fact that 53 patients became gravid two years or longer after the test should caution us against making a poor prognosis when pregnancy does not follow at once.

Of the 244 primary cases of sterility who became gravid there were 54 or 22.13 per cent who had been sterile for over five years before they were treated by insufflation. There were 68 women or 44.15 per cent of the 154 secondary sterility cases who had found themselves unable to conceive for five years or longer after their last pregnancy. Twelve patients had been sterile for more than fifteen years.

Insufflation was the only treatment employed in 247 of the 398 patients who became pregnant (62.06 per cent). The therapeutic measures besides insufflation that were employed in the remaining 149 cases are too varied to take up here.

The manner in which uterotubal insufflation exerts a therapeutic influence has been discussed elsewhere. Here it is well to recall the criteria by which to estimate the responsibility of this treatment in any given case:

1. The age of the woman should be thirty years or over.
2. Pregnancy must follow within a month or at least two months after tubal insufflation.
3. The length of marriage should be three years or longer.
4. The patient must not be treated by any other measure than by tubal insufflation.
5. The insufflation should be done within the first two weeks of a last regular period or in the preovulation phase.
6. Patients must not have taken contraceptive precautions for at least one year prior to insufflation.

Repeated insufflation accompanied by successively lower pressures and other signs of normal patency may be assumed to be therapeutic. If pregnancy takes place after such treatment it may be attributed to the insufflation.

These criteria are more or less arbitrary. But obviously, there must be some standards by which to gauge and evaluate the results of this and other measures which are adopted in the treatment of sterility and to calculate their comparative values.

Experience of most workers here and abroad with uterotubal insufflation has established the ratio between open and closed tubes. This varies between definite limits and depends upon the particular group of patients studied and upon the application of the method. In general, the difference in the reports of most authors is not great. In 26.10 per cent of my series the tubes have been found to be occluded, and in 26 per cent they were partially obstructed. These figures require no comment. They should help to evaluate the etiologic factors in sterility without minimizing or exaggerating their relative importance.

TREATMENT OF DYSMENORRHEA BY INSUFFLATION

The therapeutic effect of insufflation on dysmenorrhea, first reported by Peterson and Cron,[13] was studied in 57 cases of sterility. Twenty patients were cured of their dysmenorrhea and 18 were improved for as long a time as they were under observation; 19 patients were unimproved. Eleven patients reported relief for a year or longer, one for seven years.

SUMMARY AND CONCLUSIONS

1. Insufflation was employed as a diagnostic and therapeutic measure in 2273 cases of sterility, and in 154 additional cases for other indications. There were 3600 insufflations performed in all.

2. Genital inflammations, menstruation and the premenstrual phase, abnormal bleeding from the genital tract, pregnancy, and severe constitutional diseases contraindicate the test.

3. There were no serious sequelae in the 3600 insufflations herein considered.

4. The postmenstrual phase, from the fourth to the seventh day following the cessation of the menses is the most favorable time to insufflate the tubes.

5. The use of the uniform pressure rate flow of gas within definite time limits is essential for safety. Carbon dioxide is preferred because of its rapid resorption.

6. With the aid of the kymograph the presence of tubal patency, of nonpatency, tubal stenosis, peritubal adhesions and uterotubal spasm can be determined.

7. In the vast majority of cases it is possible to locate the site of obstruction. The decision for or against operation to open the tubes is thus rendered possible. In this respect, abdominal auscultation and careful notation of the sensory reactions during examinations are important.

8. The interpretation of insufflation results has been confirmed by experimental methods and by the findings at 186 laparotomies and 132 lipiodol examinations. In this connection it is worthy of note that although no complications arose in the 132 cases from insufflation, there were sequelae following the lipiodol in 9 cases. Three of these were pelvic abscesses requiring surgical intervention.

9. Of the 2192 sterility patients in whom the status of the tubes was satisfactorily determined, 947 or 43.2 per cent had normal patency. There were 1245 patients or 56.8 per cent who had various degrees of tubal obstruction. There were 572 patients or 26.1 per cent of the total series who had complete tubal obstructions. These figures may form a basis of comparison with other etiologic factors in sterility, and eventually help to evaluate their relative importance.

10. The incidence of tubal obstructions following induced abortions was 60.22 per cent; following appendicitis, 60.46 per cent. Obstructions were found to associate fibroids in 57.96 per cent and retroflexions in 65.18 per cent. The residual tube following an extrauterine pregnancy was found obstructed in 81.94 per cent.

11. The contraction rate, amplitude and uterotubal tonicity are increased in patients insufflated during the 10th to the 16th day of the menstrual cycle, i. e., at the time when we would expect ovulation to occur.

12. The contraction rate, amplitude, and uterotubal tonicity are decreased in functional amenorrhea of young women, during the menopause and after x-ray castration.

13. Tubal insufflation appears to have a definite therapeutic value in sterility. This is demonstrated by actual improvement in tubal patency and function during prolonged or repeated insufflation as recorded on the kymograph, and by pregnancy which follows soon afterward.

Of the 398 patients who became gravid after insufflation, 123 or 21.58 per cent had peritubal adhesions or stenosed tubes. In this respect insufflation may be considered as a nonoperative method of salpingolysis.

There were 67.59 per cent of the gravidities that took place during the first six months after insufflation, 42.21 per cent within two months, and 27.89 per cent within a month.

Of the 244 primary cases of sterility who became pregnant, 22.13 per cent had been married for over five years before they were treated by insufflation. Of the 154 secondary cases of sterility who had found themselves unable to conceive for five years or longer after their last pregnancy 44.15 per cent also became pregnant after treatment. Pregnancy followed treatment in 12 women who were sterile more than fifteen years.

Insufflation was the only treatment employed in 247 of the 398 cases that became pregnant (62.06 per cent).

14. Improvement of dysmenorrhea followed insufflation in 66.6 per cent of 57 patients.

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THE SELECTION OF APPROPRIATE OPERATION FOR THE CURE OF PROLAPSE*

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MY INTEREST in the treatment of vaginal and uterine prolapse dates back more than twenty-five years. From 1914 to 1917 I studied the anatomy in detail and in 1917 described a technic applicable particularly to cystocele.[1] In 1923 an even more detailed publication of the operative technic, based on the anatomy of the parts, was published.[2] Since then my interest has continued unabated and I have tried out a number of operations applicable to certain special cases. In the main, however, my interest has centered in perfecting a technic applicable to the average case.

Injuries to the birth canal may be grouped under three headings which are noted alone or in combination. The main types are descent of the anterior (cystocele) and posterior (high and low rectocele) vaginal walls, and descensus of the uterus. These occur in various degrees of severity and may be complicated in the case of cystocele, with incontinence, and in the case of both cystocele and descensus, with kidney damage. No two cases are alike. Almost always these conditions appear in parous women. Only exceptionally are they found in the nullipara and then most frequently as a sequel to the nerve injuries accompanying spina bifida.

In describing the anatomy previously, I have followed the accepted scholastic descriptions which unnecessarily complicate the subject.[1, 2] From the viewpoint of the operator, the position and motility of the cervix, and to a large degree, dependent on this, the tenseness and intactness anteriorly of the pubocervical tissues, and posteriorly of the firmness of the rectovaginal planes as well as the depth of the Douglas culdesac, are the main features to be considered. This does not signify that the position of the fundus is entirely negligible. The levator ani and its fasciae appear to play a minor rôle in repair although the intactness of this diaphragm safeguards greatly against the development of descensus. In repair, however, the levator and its fasciae serve merely as accessory aids and are utilized in fixing the midportion of the rectum and in building up a strong and efficient perineum.

The nature of the injury plays the leading, but not the exclusive rôle, in determining the anatomic lesion and its extent. The site of the injury, its degree, its type, whether due to stretching of the structures or to submucous or open tears, each play their part.

More and more attention has been focused, as the years have passed, upon the constitution of the patient, including the general body con-

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figuration, the robustness or its opposite, the asthenia, the presence or absence of enteroptosis, the strength or weakness of the fasciae, and the complication of obesity. In other words, the constitution or make-up of the patient appears to play a not inconsiderable rôle, which if I should venture to put it upon a percentage basis, would influence at least 25 per cent in favor of or against a successful result.

Moreover, individually varying factors, such as age handicap, poor surroundings and poor living conditions, somatic complications especially cardiorenal diseases, pulmonary troubles, particularly bronchitis and emphysema, markedly influence the outcome and play an important part in the proper selection of operative procedures. Social conditions are of utmost importance. The results in my private practice, composed largely of women in favorable surroundings and able to take good pre- and postoperative care of themselves, are immeasurably better than in the ward cases, consisting of a group of women who soon, postoperatively, must return to hard and continuous work.

An unusually careful follow-up, undertaken by Drs. Howard Lindeman and Max Mayer, just completed, has given me much additional information. This follow-up was performed with a scrupulous exactness, with every effort to minimize success and accentuate failure. Of 480 cases available, only 414 were accessible to this minute scrutiny. Of these, 183 have as yet been followed up for less than a year (three months to twelve months). There have been 231 cases followed up from eighteen months to two years or more. From my point of view the results are extremely discouraging.

Good	46%	Satisfactory	66%
Adequate	20%		
Inadequate	16%	Unsatisfactory	34%
Poor (including hernia)	18%		
Improved	82%		

Among the poor plastic results are included 21 patients who developed ventral, incisional hernia after ventrofixation. In this group of 21, the vaginal repair was good in 16. Hernia developed in 21 of 200 ventrofixations (10.5 per cent).

The occurrence of hernia after ventrofixation appears to be directly proportional to the amount of drag exerted by the uterus, and exceeds immeasurably the number of hernias found in other laparotomies, 0.8 per cent.

Another noteworthy observation was the fact that incontinence in the absence of cystocele, rectocele, or prolapse (5 cases) was not cured in any. This is in sharp contrast to the general run of incontinence cases of which 62 per cent were cured by operation.

The operations performed over many years for the cure of cystocele,

rectocele, and prolapse consisted of vaginal plastic repair and ventrofixation.

Anterior colporrhaphy was done according to the technic described by me in 1917,[1] in which the bladder is fully mobilized and the pubocervical tissues united in the midline, their cervical base being attached higher up on the anterior surface of the uterus.

The operation for rectocele consisted, in low rectocele, in the exposure and freeing of the rectum, exposure of the fasciae covering the levators

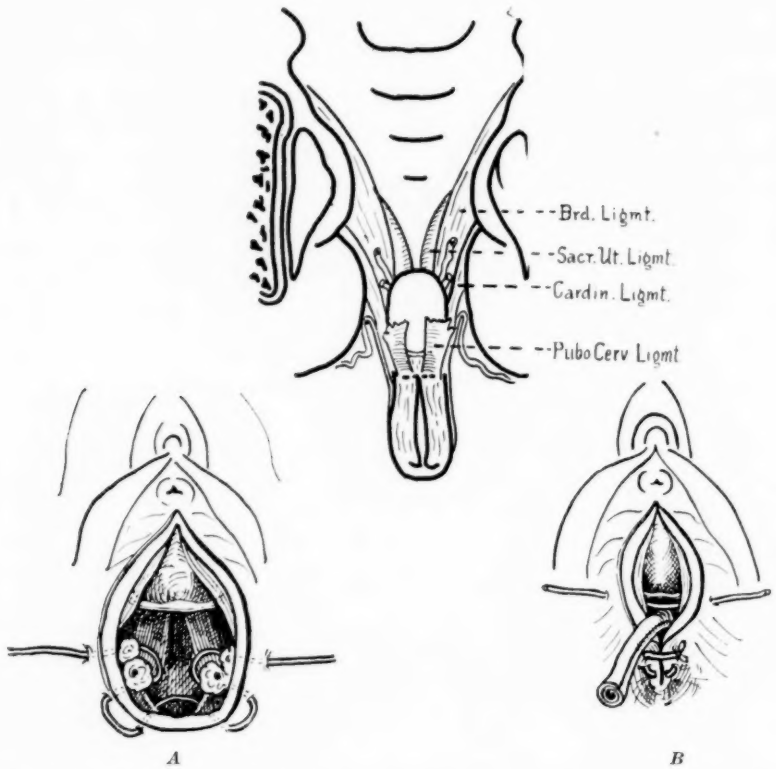

Fig. 1.—Vaginal hysterectomy for prolapse. Top center, schematic transverse section of pelvis showing uterus pulled down with elongation of all ligamentous and cellular structures. Transverse dotted line at internal os. *A*, uterus removed. Parametria ligated. Suture shown before tying, including cardinal ligaments, sacrouterine ligaments and posterior vaginal fornix. *B*, suture tied. Intraperitoneal rubber tissue drain. First anterior suture passed.

which, without baring the muscles, were brought together in the median line. In the case of high enterocele, the Douglas pouch was mobilized, shortened by a purse string, and the sacrouterine ligaments, cervix and anterior rectal fasciae united to close the hernial opening.

Uterine prolapse in the majority of instances was treated by ventrofixation, using either the intraperitoneal or extraperitoneal technic.

For incontinence, the Kelly technic has usually been employed, bringing together in the midline the tissues at the base of the bladder and over these fasciae the pubocervical tissues.

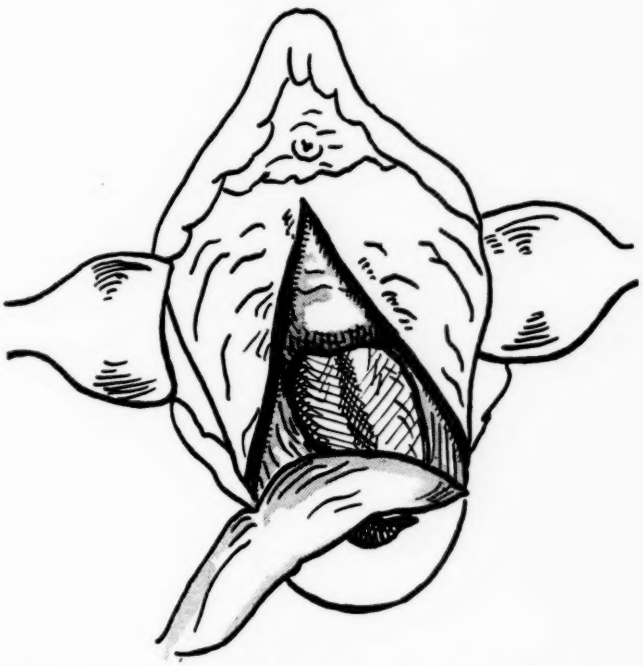

Fig. 2.—Fothergill operation. This and the following figures illustrate the anterior denudation, vesicocervical band cut across, bladder pushed back showing pubocervical tissues laterally.

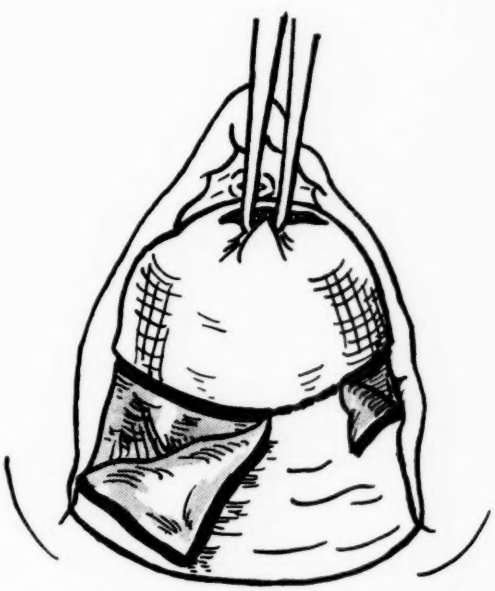

Fig. 3.—Posterior line of incision to expose pouch of Douglas and sacrouterine ligaments.

For special indications, various other operations have been employed. For large isolated billiard ball cystocele, an occasional interposition operation was used. In women of advanced age, with complete prolapse, the Le Fort operation has proved very satisfactory. In 1929 I reported on a modification of Polk's intraabdominal cystocele operation.[3] This operation is of value where hysterectomy must be performed, usually for fibroids of the uterus, and in which to overcome an apparent or potential prolapse, the cervical stump requires ventrofixation in the abdominal wall. Before performing the fixation, the cystocele

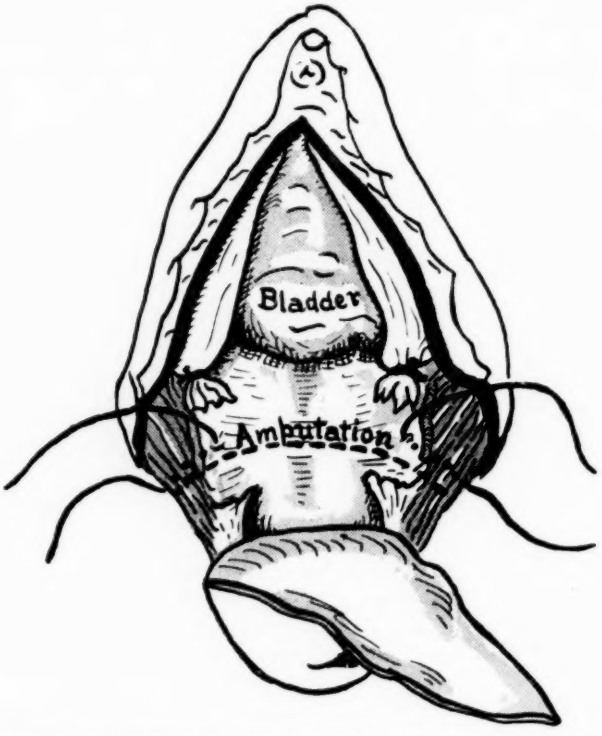

Fig. 4.—Pubocervical tissues ligated and cut away from cervix. Lateral hemostatic sutures (not tied) traverse cardinal ligaments and include uterine arteries. Line of amputation indicated.

can be cured by the Polk technic. The operation, however, does not lend itself to general use in the treatment of prolapse.

Realizing that better results should be obtained, in the last two years I have occasionally resorted to vaginal hysterectomy as advised years ago by Fritsch,[4] and more recently advocated by Mayo,[5] Ward,[6] and others.

The history of vaginal hysterectomy for prolapse is an interesting one. The first reference to the operation appears to be Choppin* of New Orleans, who in 1860, after repeated unsuccessful resection and

*_Choppin:_ New Orleans Med. News & Hosp. Gaz. **7**: 939, 1860, and South J. M. Sc. **1**: 622, 1866.

plastic repair, performed vaginal hysterectomy with removal of part of the vaginal mucosa by means of the ecraseur. The vault was closed with silver wire and lead clamps without drainage. Cure was affected, the patient dying four years later from dysentery.

In Germany Freund, Fritsch, Asch, et al., reported results during 1889.

In this country the operation was practiced sparingly until the last decades when it has again gained in popularity.

At the outset, I followed the directions given by Mayo and Ward,

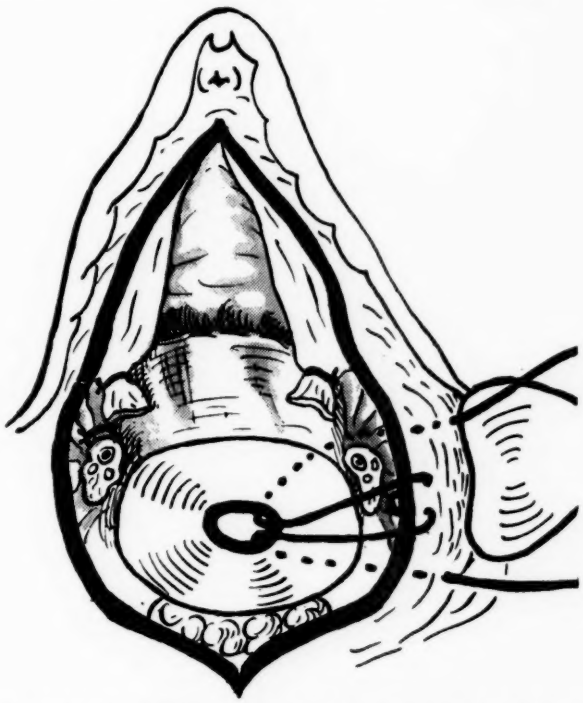

Fig. 5.—Cervix amputated. One lateral cervical suture passed including cardinal ligaments, cervix and mucosa of left fornix.

including the union in the midline of the stumps and their suture to the pubis. After becoming more familiar, not only with the operation but also with its results, I have found it unnecessary to resort to this more or less complicated technic and find that a rapid vaginal hysterectomy, with appropriate resection of the entire thickness of the anterior vaginal wall, suffices. The two upper stumps are released but extraperitonealized, all attention being focused upon the lower stumps containing the base of the broad ligaments (cardinal ligaments) to which the vault of the vagina, including not only the mucosa but also the fascial structure (pubocervical tissues, sacrouterine ligaments, and posterior vaginal fornix) are approximated in the midline. This gives not only a firm vault but because of the shortening and union of the tissues, with-

out the interposition of the cervix which has been removed, raises the vault high into the middle of the pelvis and affords efficient support to the fornix as well as to the bladder. The posterior repair which concludes the operation, overcomes rectocele and descensus of the posterior vaginal wall.

As a sequel to the satisfactory result obtained in the majority of cases by vaginal hysterectomy, it followed naturally that my attention should be attracted to the technics so widely practiced in Great Britain, the "Fothergill" operation[7] which came into question in younger women in

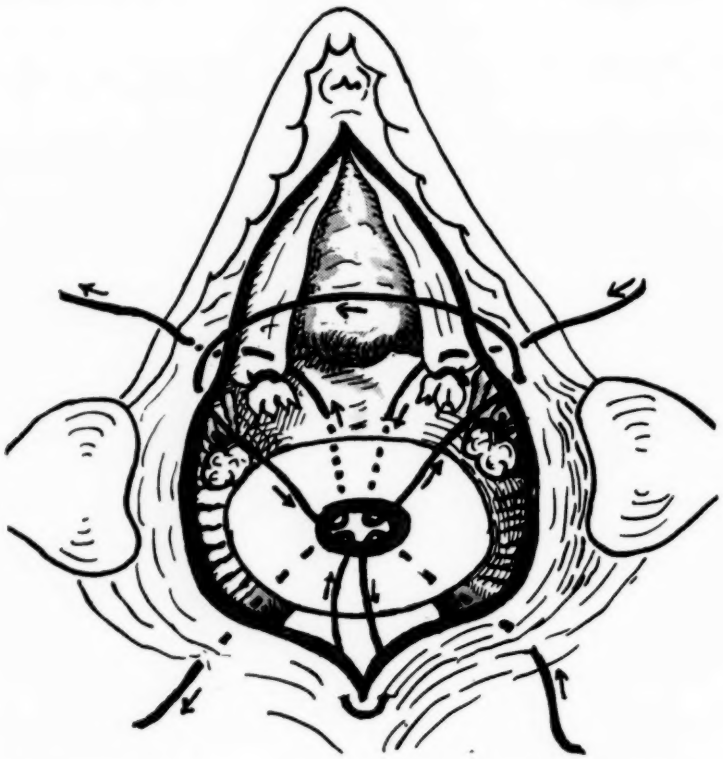

Fig. 6.—Anterior and posterior sutures passed. Anterior suture includes vaginal wall, pubocervical structures and cervix. Posterior suture includes posterior vaginal fornix, sacrouterine ligaments and cervix.

whom removal of the uterus was not indicated and was to be avoided if possible. My experience with the Fothergill operation, which dates only from the beginning of this year, has been interesting and promises to prove satisfactory because it fulfills the anatomical essentials, namely the bringing together of the bases of the broad ligaments as well as shortening of the pubocervical structures. During the writing of this paper an article from Halban's clinic by Mestitz[8] elaborately describes an identical procedure which Halban has practiced since 1919. This

encourages me greatly as, with the exception of Tandler and Martin, no one else has studied the anatomy of this region to the same extent as Halban.

These operations, whether we call them the Donald-Shaw-Fothergill, which were initiated in England by 1888, or Halban's, first practiced in 1919, may solve our difficulties although in special cases, as before, other technics such as those of Watkins, Wertheim, Schauta, Kielland, Le Fort, Polk, Fritsch, Mayo, Ward, will doubtless find their special application.

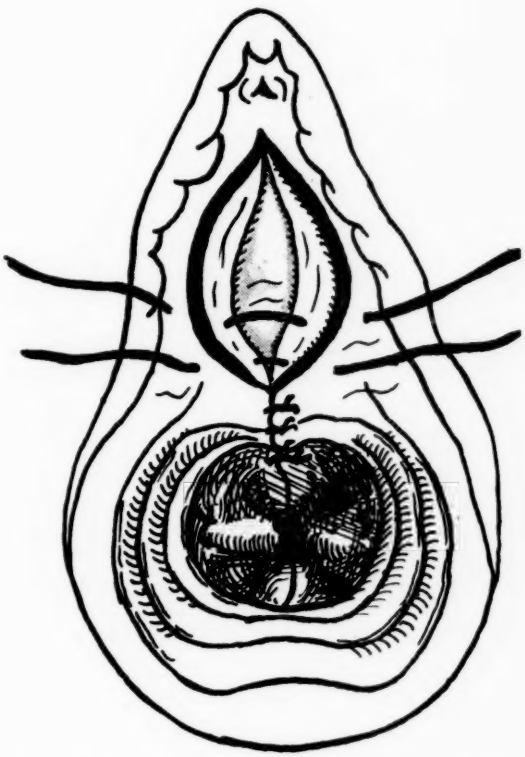

Fig. 7.—Suture of cervical stump and fornices completed. Cervix released and retracted. Two sutures have been passed through mucosa and pubocervical structures to hold back bladder.

In conclusion I would say that in my hands and those of my group, the results obtained for the cure of prolapse, are not as satisfactory, when critically examined, as those of other gynecologic operations.

This applies particularly to the cure of incontinence, the frequency of ventral hernia when laparotomy is performed, a perfect anatomical restoration in vaginal repair.

The best results were obtained in cases of rectocele and cystocele, unaccompanied by descensus.

Based upon this careful taking of stock in a considerable series, in

future I plan to continue the use of our technic for anterior and posterior colporrhaphy in cystocele and rectocele unaccompanied by prolapse.

In the absence of cystocele and presence of incontinence, not to subject patients to operative intervention unless every psychical and neurologic cause for this condition can be excluded. If operation is to be performed, I intend to use a transverse fascial strip, either free or pedicled across the neck of the bladder. In the presence of prolapse, in young women, to employ the Fothergill operation; in old women with complete prolapse, to utilize the simplified vaginal hysterectomy.

As previously stated, in the course of abdominal hysterectomy complicated by descensus and cystocele, to employ the Polk operation with ventrofixation of the stump.

In poor operative risk in the aged, as heretofore, the Le Fort operation.

The statistics gathered by Lindeman and Mayer have convinced me that no personal follow-up, except if performed over a considerable period of time by the same, preferably overcritical individuals, is of value. Follow-up conducted by means of post card, reports of outside physicians, or based on early results, are misleading and of no value.

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10 East Eighty-Fifth Street.

CONGENITAL ABSENCE OF THE VAGINA AND ITS TREATMENT*

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CONGENITAL malformations of the female genitalia extensive enough to interfere with function or with normal habits are sufficiently common to warrant the serious consideration of physicians.

The developmental defects of the vagina may be grouped as follows: aplasia, atresia, hypoplasia, duplication and various combinations of aplasia, atresia, hypoplasia and duplication.

Aplasia.—Entire absence of the vagina is usually associated with absence or arrested development of the uterus and sometimes also of the tubes. Frank stated that in most cases of congenitally absent or defective vagina, except when a septum is present, the uterus is functionless and there are no symptoms of retained menstrual blood at puberty. In the extreme forms, the entire vagina is represented by a fibrous or fibromuscular cord situated between the bladder and the rectum with the uterus usually maldeveloped, often solid, and divided into two parts. The hymen may be absent or well developed.

Atresia.—The atresia may be transverse and in this plane may be complete or incomplete. Diaphragm-like membranes result from incomplete canalization of cells in one or both segments. The favorite sites are at the juncture of the lower and upper part with the middle third of the organ. On the other hand, there may be long solid areas to either side of the median line without a lumen, due to failure of canalization of a considerable portion of one müllerian duct.

Because it is difficult to explain marked developmental inhibition of the müllerian ducts, in which the uterus or upper part of the vagina is absent, but the lower third and the vulva are normal, Wharton and Masson have stated the belief that the vagina has a dual origin, the upper two-thirds being derived from the müllerian ducts and the lower third from the external genitalia. If one accepts the view of Felix that the whole vagina develops from the müllerian ducts, there may be lateral atresia of the vagina, because one lateral half of the vagina is imperforate. Thus with uterus unicornis, a narrow, somewhat laterally situated vagina may be formed from the lower end of one müllerian duct.

Hypoplasia.—This condition is characterized by shortness and narrowness of the vaginal canal. The rugae and vaginal folds are flat and meager. The posterior upper vaginal pouch is shallow or absent, and the cervix points in the direction of the vaginal axis or toward the bladder. This is quantitative rather than qualitative development.

Duplication.—This may be considered as true duplication or pseudoduplication. Frank cited two cases of true duplication in each of which there were widely separated uteri, two vulvae, two urinary bladders and duplication of the lower part of the spinal column.

Under the group of false duplication may be considered vaginas resulting from partial or complete failure of absorption of the fused adjacent portion of the müllerian ducts, resulting in complete or partial vertical septums being left in the vagina.

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Various combinations such as atresia and duplication in the same patient are occasionally found. In the last two years I have observed six patients with complete absence of the vagina. I performed a transplantation of small bowel as described by Baldwin on five of them. As a rule the condition is not recognized until the age of puberty, as the external genitalia usually appear more or less normal. In many instances it is not recognized until marriage is contemplated. Such patients, as a rule have other anomalies of the internal genital organs, the most common of which is aplasia or rudimentary uterus with no endometrium and no

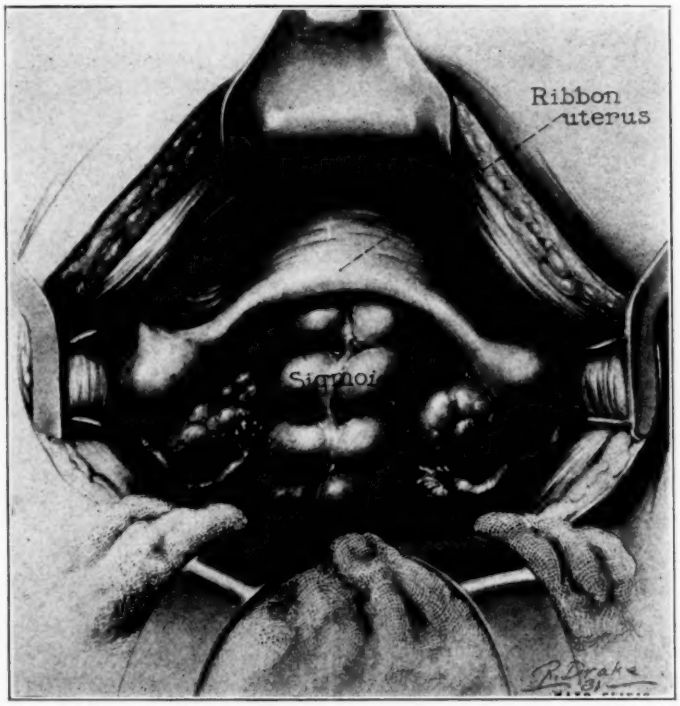

Fig. 1.—Exposure of solid rudimentary uterus. Condition usually found in complete absence of the vagina.

tendency toward the development of hematometra (Fig. 1). If the ovaries are present these patients are normal, but unless a vaginal canal can be constructed they will not be able to look forward to marriage. In many instances a marked sex complex and neurosis develop making patients very unhappy and unable to take their place in society. Several cases are on record in which the urethra has been sufficiently dilated to allow sexual intercourse. One such patient who came under my care died of infection of the urinary tract as the result of such a practice.

Of importance is the psychologic consideration of these patients. Assurance that the condition is not so very uncommon and that it, per se, will not in any way interfere with their normal health will do much to satisfy them. All operative interference should be postponed if possible

until marriage is contemplated. Many surgeons believe that surgical interference should never be advised for this condition, but when a patient with this condition makes up her mind to be married or wants the condition corrected, no amount of argument or advice will change her and suicide is often contemplated. Judin observed two such cases.

It will be possible here to give only a short description of the development of the müllerian ducts from which the entire internal genital tract of the female develops. From the fifth to the sixth week with the development of the genital glands on the mesial side of the wolffian bodies, the müllerian ducts develop on the lateral aspect of the wolffian ducts as a tubular invagination of the cells lining the coelom. The orifice of the invagination remains patent and undergoes enlargement and modification to form the abdominal ostium of the uterine tube. The müllerian ducts pass backward lateral to the wolffian ducts, but toward the posterior end of the embryo they cross to the mesial side of these ducts and end in an epithelial eminence, the müllerian eminence on the central part of the cloaca, between the orifices of the wolffian ducts; later they open into the cloaca at this situation.

From the müllerian ducts develops the entire internal female generative tract to the vaginal introitus. The müllerian ducts are at first solid and extend to the urogenital sinus as separate, unfused structures. The fusion of the lower half of the müllerian ducts is complete in the ninth week of fetal life, the vagina still being solid but the uterus composed of two hollow compartments. The septum of the fused walls forming the uterus disappears from below upward. This part of the canal is lined by a single layer of epithelium and has two hollow compartments, whereas the vagina is still solid, being composed of large cells rich in protoplasm. The uterine musculature develops about the fourth month.

In the fourth to the fifth month, the uterus and vagina acquire a single communicating lumen. The uterus and vagina are distinguished from each other by the formation of the cervix at the beginning of the fifth month. The hymen appears in the fifth month as a special differentiation of the lower vaginal segment and represents the remains of the müllerian eminence.

In the male, the müllerian ducts atrophy, but remnants of their anterior ends are represented by the appendix testis or the hydatid of Morgagni, whereas the terminal fused portions form the utriculus in the floor of the prostatic portion of the urethra.

OPERATIVE PROCEDURES

Two types of operation have been advised for congenital absence of the vagina: plastic flaps of skin taken from the labia or thighs as advised by Graves, Davis and Cron, Frank and Geist, Grad, and others, or resection of a portion of the intestinal tract, retaining its blood supply and implanting it in the normal situation of the vagina, as advised by Baldwin, Schubert and others. There are advantages and disadvantages in both these methods, but I believe that unless the canal is lined with mucous membrane it will not be very satisfactory. Not only is there more danger of cicatricial contraction but surfaces of skin in close apposition, unless they are kept scrupulously clean, will tend to macerate and become infected. We have all seen examples of this in a deep, funnel-shaped umbilicus, or beneath pendulous breasts or in the fold beneath a pendulous abdomen. Another disadvantage of such operations is the unnatural dry surface. Graves stated that the skin becomes soft, moist and devoid of hair in six weeks. This is probably more likely to occur

when most of the tissue is obtained from the labia than when skin from the thigh is used. On the other hand, Bumm reported a case in which hair continued to grow on the flap and it had to be removed. The chief recommendation of such operations is that they are relatively safe, but failures must be frequent. In two of the cases in which I have operated, previous plastic operations had been attempted. Furthermore plastic flaps require several surgical procedures and long hospitalization, and in case of necrosis after insertion between the bladder and rectum there is danger of a spreading infection in the retroperitoneal tissues, and any secondary surgical procedure will be more difficult.

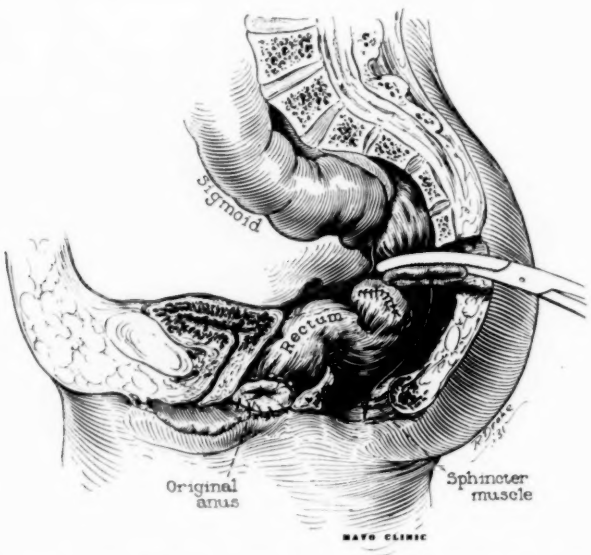

Fig. 2.—Popov-Schubert operation; utilizing rectum for vagina.

The Popov-Schubert operation consists in utilizing the lower 12 cm. of the rectum for a vagina, drawing the upper part of the rectum down through the sphincter muscles and attaching it to the skin (Fig. 2). It is a relatively safe procedure as the peritoneum is not opened, but any operation on the large bowel predisposes to local infection and sepsis, and if the newly constructed anal canal does not hold to the edges of the skin there is danger of incontinence and obstruction. However, the operation has been performed successfully by many operators in Germany. Wagner of Prague reported a case in which operation was performed at the age of thirteen years. The uterus was normal, the patient later became pregnant, and a child was delivered normally. The operation has much to recommend it, and Schubert claims a mortality rate of 3.2 per cent in 95 reported cases.

In 1904, Baldwin suggested using a segment from the sigmoid flexure to make a new vagina (Fig. 3), and in 1907 he suggested using a loop of ileum. I have operated on five patients, using the ileum, and have recently received answers to questionnaires sent to them. They are all well satisfied with the results. One of the objections to the operation is the high mortality rate, quoted by some as 17 per cent and by others as 6 per cent, but I feel that if proper care is taken not to make undue tension on the loop of ileum, there should be no real risk from operation, and

the mortality rate should be below 6 per cent. Another objection to this operation is the free discharge that the patients complain of, but it should be remembered that they have never been used to menstrual periods and have never had any leucorrhea; in most cases the discharge is relatively slight and never causes irritation of the skin. It can be reduced to some extent by not making the loop of ileum any longer than is necessary. In the occasional case it may not be possible to find a loop of ileum that can be brought down to the perineum, and in such event it will be advisable to use a loop of sigmoid or close the abdomen, and later to perform a Popov-Schubert operation, using the ampulla of the rectum. If the loop of sigmoid is used, the result should be satisfactory as there would be no increase in mucus secretion, but the risk of the operation would be definitely greater than if the small bowel is used.

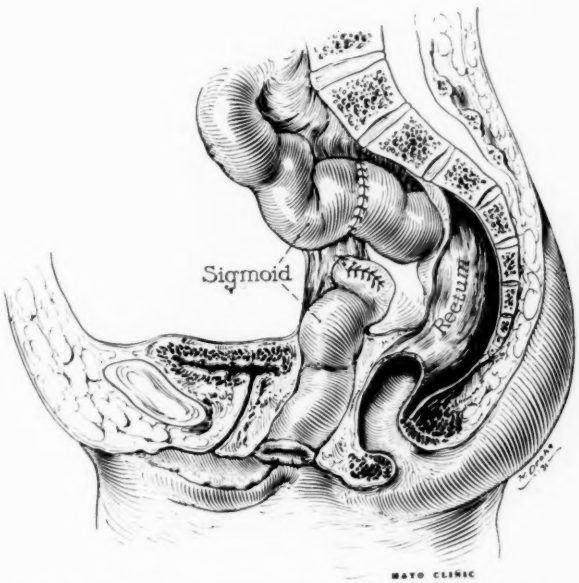

Fig. 3.—Construction of vagina from a loop of sigmoid.

ABSTRACTS OF CASES

CASE 1.—A divorced woman, aged nineteen years, came to The Mayo Clinic October 21, 1929. Her chief complaint was congenital partial absence of the vagina. The patient had been married in June, 1928, at which time the congenital defect was discovered. In July, 1928, an attempt was made to dilate the vagina without much success. The patient had never menstruated.

Examination disclosed a short vagina, measuring about 5 cm. Otherwise, all characteristics were apparently normal and sexual sensations were normal. The urinalysis was essentially negative and the hemoglobin was 14.1 gm. in each 100 c.c. of blood. The Wassermann reaction of the blood was negative. Although the patient was divorced she wanted the operation as she felt that it would make a difference in her mental reaction toward life.

October 24, 1929, a Baldwin type of operation was performed. The tubes and ovaries were normal. On each side of the pelvis was a small, rudimentary uterine horn, apparently without mucous membrane as there was no tendency toward hematometra. Convalescence was uneventful and the patient was dismissed November 20, 1929. Before leaving the clinic she was instructed in the use of a

dilator; the use of this did not cause pain or discomfort. She stated in a letter dated October 28, 1931, that her health is practically on a par with what it had been before the operation. Her only complaint was of a discharge, noticeable chiefly during the process of digestion. She has not yet remarried, but she stated that she uses the dilator only at rare intervals, and with ease.

CASE 2.—A single woman, age twenty-three years, came to the clinic November 4, 1929. She complained chiefly of amenorrhea. At the age of fourteen years she began to have irregular cramps low in the abdomen, occurring at intervals of two or three months. At the age of sixteen years the cramps became regular every month. However, menstrual flow had not appeared. The cramps were likely to last from three to five days, occasionally confining the patient to bed. In 1922 appendectomy had been performed because of these pains.

Examination disclosed congenital absence of the vagina, hematometra and double uterus. The urinalysis was essentially negative and the hemoglobin was 12.5 gm. for each 100 c.c. of blood. The Wassermann reaction of the blood was negative.

November 6, 1929, exploration was carried out through a low, median line incision and a congenital anomaly was found, consisting of a double uterus widely separated on each side of the pelvis. Each side of the uterus had a normal tube. The ovary on the left side apparently was normal, but the ovary on the right contained a tarry cyst about 6 cm. in diameter. Each uterine body contained a small amount of endometrium and the cavity was dilated with retained menstrual fluid. Both parts of the uterus, both tubes and the right ovary were removed and an entero-anastomosis was made between two loops of ileum close to the ileocecal valve with the idea of using this part of the bowel to make a new vagina later.

November 20, 1929, a Baldwin type of operation was performed. After an uneventful convalescence the patient was dismissed from the clinic December 11, 1929. June 2, 1930, the patient wrote that since her return home she had married and was pleased over the result of the operation. We heard from her again about November 25, 1931, at which time she stated that the results had been very satisfactory but that there was considerable discharge.

CASE 3.—A single woman, aged twenty-eight years, came to the clinic August 6, 1930. Ten years before this a local physician had examined her because of amenorrhea, and absence of the vagina and uterus was discovered. The patient had not experienced pelvic cramping or pain, but occasionally had noticed soreness of the breasts.

Examination showed that the external genitalia were well developed. The vagina was congenitally absent, there was only a small pocket about 1.5 cm. deep. The ovaries and uterus could not be palpated. Urinalysis was negative, and the hemoglobin was 16.4 gm. for each 100 c.c. of blood. The Wassermann reaction of the blood was negative. The patient contemplated marriage and operation was advised.

August 29, 1930, a Baldwin type of operation was performed. Apparently normal tubes and ovaries and a ribbon-like uterus were found. A small amount of tissue on each side of the pelvis did not contain endometrium. Convalescence was uneventful and the patient was dismissed feeling well September 16, 1930, but the discharge of mucus through the vagina was free. In February, 1931, we received a letter from the patient in which she stated that she had married and that her married life had been extremely happy. She did not mention a discharge.

CASE 4.—A widow, aged thirty-eight years, came for consultation October 6, 1930, because of lack of a vaginal orifice. She had never menstruated and had not had sexual intercourse. Plastic operations on the vagina had been attempted twice.

Examination did not disclose abnormalities, except congenital absence of the vagina and a great deal of scarring about the vulva. Urinalysis was essentially

negative and the hemoglobin was 12.6 gm. for each 100 c.c. of blood. The Wassermann reaction of the blood was negative.

October 9, 1930, a Baldwin type of operation was performed. A vaginal canal about 2 cm. long, the result of two previous plastic operations on the vagina, was found. Tubes and ovaries apparently were normal. The two halves of the uterus were widely separated; they were lying along the pelvis and were united in the middle by a fibrous ridge and did not contain endometrium. Convalescence was uneventful except for pyelonephritis on the left side, but at the time the patient left the hospital this had cleared. She was dismissed from observation December 3, 1930, at which time the operation appeared to be successful. A letter from the patient dated October 24, 1931, stated that the operation had been successful and that the discharge is only about half as much as that which immediately followed operation. She has not remarried.

CASE 5.—A single woman, aged twenty-four years, came to the clinic June 16, 1931, because of congenital absence of the vagina. She was otherwise perfectly developed and stated that she had normal sexual sensations. She had not, however, menstruated.

Urinalysis was negative and an examination of the blood showed a hemoglobin of 12.9 gm. for each 100 c.c. The Wassermann reaction of the blood was negative.

A Baldwin type of operation was performed June 20, 1931. On rectal examination evidence of a uterus could not be found, but at the time of operation a small amount of uterine tissue was discovered on each side of the pelvis with apparently normal tube and ovary attached. An endometrial cavity in the uterine tissue could not be found. Convalescence was uneventful. The patient was dismissed from observation July 30, 1931, and given two vaginal dilators, 2.5 cm. and 3.5 cm., with instructions to insert a dilator once or twice a day and leave it in place twenty minutes or half an hour each time. She was married September 1, 1931, and in a recent letter she stated that she is pleased with the result of the operation and has had no trouble with her married life. Her only complaint is the discharge, which she thinks is definitely less than when she left the clinic.

COMMENT

This operation must be looked on as a major procedure, but for surgeons accustomed to operating on the gastrointestinal tract, the mortality should not be higher than for other benign conditions. The operation should be completed in from one hour to one and one-half hours, and the patient should not be in the hospital more than four weeks. The steps of the operation are as follows:

1. By blunt dissection a cavity is made in the soft tissue between the bladder and rectum up to the peritoneum and packed with gauze. In most cases the external genitalia are more or less normally developed and dimpling represents the position of the vagina.

2. The abdomen is opened and a section of small bowel about 20 to 25 cm. long with mesentery sufficient to allow it to reach to the perineum is resected. As a rule, this loop will be found in the lower part of the ileum. The continuity of the intestine is reestablished preferably by suture; side-to-side or end-to-side anastomosis is just as satisfactory and a little safer than end-to-end anastomosis on account of some interference to the blood supply as the result of freeing the mesentery of the detached section or as result of traction. The ends of the detached section are securely closed by purse-string sutures or by end-to-end union, and the low point of the loop is then drawn down into the excavation made between the bladder and

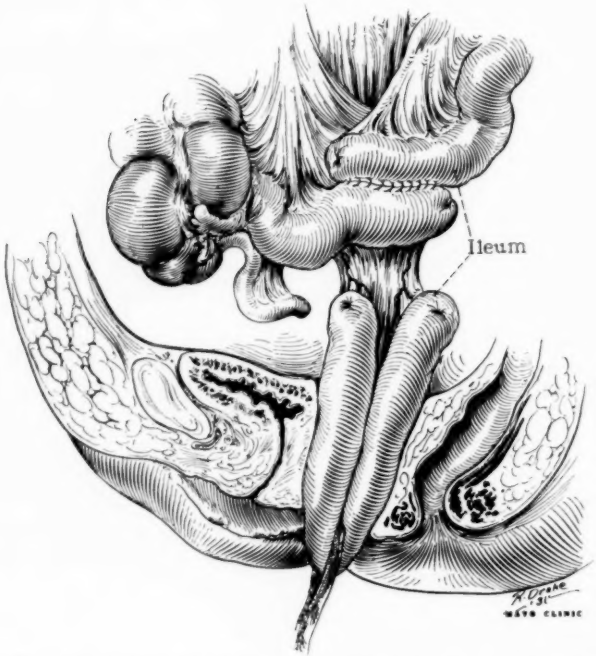

Fig. 4.—Loop of bowel drawn down in the space made for vagina (Baldwin). Blood vessels may be noted in the edge of the mobilized mesentery.

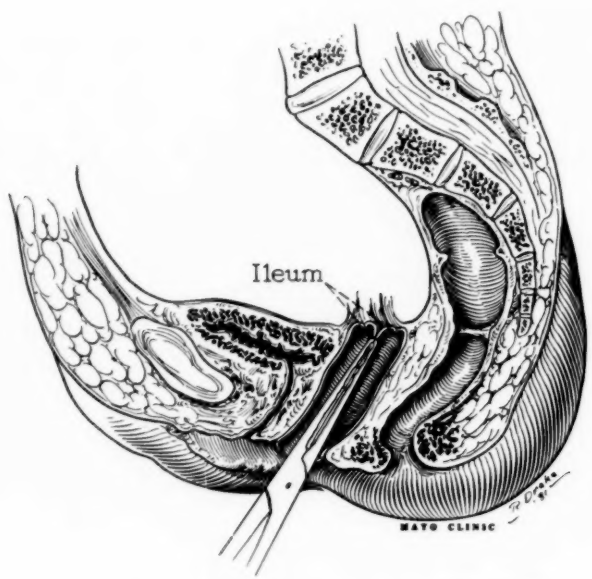

Fig. 5.—Clamps applied to destroy the septum in the newly constructed vagina (Baldwin).

rectum and the mobilized loop of ilium covered by peritoneum as thoroughly as possible (Fig. 4). To avoid interference to the blood supply it is advisable to leave large vessels at each end of the resected loop rather than one in the middle where the tension is greatest.

3. The abdominal wound is closed.

4. The presenting loop of bowel in the perineal wound is opened and securely stitched to the skin of the vulva by interrupted silk sutures.

5. The two sections of the bowel are lightly packed with sterile gauze.

6. In ten days or two weeks the septum between the two sections is destroyed by applying two forceps to it and allowing them to remain in place until they cut through (Fig. 5).

7. After twenty-one days a dilator about 3.5 cm. in diameter should be inserted for two hours each day for several weeks, or until marital relations are satisfactory.

SUMMARY

Congenital absence of the vagina is a rare condition, but is common enough to warrant serious consideration.

Handling of cases from the psychologic standpoint is important, and operation should never be urged.

Operation should not be advised until marriage is contemplated unless hematometra develops as the result of retained menses in a more or less normal uterus. If patients insist, operative correction is justifiable at any time.

Two types of operation, the use of skin flaps or sections of the bowel may be employed. I believe that a section of small bowel used as advised by Baldwin gives the best functional results, and although a more dangerous operation, it is relatively safe when properly done. It is, moreover, justifiable.

A dilator should be used until healing is satisfactory.

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THE TREATMENT OF GONOCOCCAL INFECTIONS BY ARTIFICIAL (GENERAL) HYPERTHERMIA*

A Preliminary Report

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FOLLOWING the results obtained in the treatment of general paresis by infection with malaria, the treatment of this disease has been undertaken by raising the body temperature by artificial means and maintaining this for a period of some hours—artificial, generalized hyperthermia. Other types of disease have also recently been subjected to this principle of therapy with some degree of success.

It was found in our laboratory (Carpenter et al.) that of fifteen strains of gonococci studied, many of these could be killed by subjecting them to a temperature of 41.5° C. for a period of from five to eight hours in a water-bath, though a few strains required an even longer period of time than this, occasionally as long as twelve hours being necessary. From previous observations, as yet unpublished (Warren et al.), on the treatment of general paresis and other conditions, it was found that when certain precautions were observed, the human body tolerated very well a temperature artificially elevated to 41.5° C. and maintained at that level for from five to seven hours. The shorter period of five hours was, however, the one most frequently employed and was better tolerated than the longer period.

With these facts demonstrated, it seemed logical to expect that the usual strains of gonococci could be destroyed in the body by making use of this principle, subjecting the infected woman to an artificial general hyperthermia of 41.5° C. (106.7° F.) and maintaining this for several hours.

We present herewith a preliminary report on the observations made and the results obtained following this line of therapy in a small group of patients.

TECHNIC OF THE PROCEDURE

As at present carried out, preliminary sedatives are given, and these must be carefully chosen. We have found it most satisfactory to administer sodium bromide 2 gm. and barbital 0.650 gm. two hours before the treatment is begun. Chloral hydrate 0.486 gm. is given by mouth at the beginning of the treatment and this latter may be repeated three hours later. Following this medication the patients usually rest or sleep quietly during the period of hyperthermia. During treatment the patient is encouraged to drink water freely while awake. The patient is placed lying on a cot in a well insulated cabinet, the head being allowed to remain outside.

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*Read at the Fifty-Seventh Annual Meeting of the American Gynecological Society, May 30 to June 1, 1932, at Quebec, Canada.

The temperature of the air in the cabinet surrounding the patient's body is heated by means of several carbon filament lamps totalling about 650 watts. The body temperature is raised by passing diathermy current through the thorax between block tin electrodes held in place by a many-tailed binder. The elevation of the body temperature by the short-wave (30 meters) radiotherm apparatus is equally efficient. After the desired temperature level has been attained (41.5° C.) as indicated by a rectal thermometer, and which will require an hour and three quarters, the current is shut off and the electrodes removed. The body temperature can then be easily and accurately maintained by means of the light bulbs in the cabinet, turning them on or off as indicated. With a well insulated cabinet, heat loss from evaporation of sweat is minimal, and may be further reduced by increasing the humidity of the air in the cabinet by placing an open vessel of water in it. After the patient has been subjected to high temperature for the desired length of time, usually five hours, the lights are shut off, the cabinet opened, and the patient's

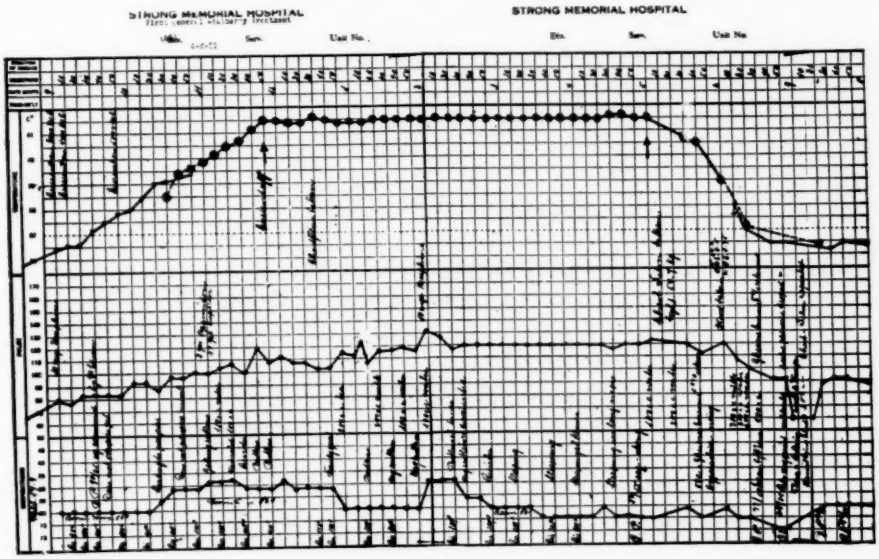

Chart 1.

body exposed to the room air. The resulting fall in temperature may be expedited by exposing the patient's body to a stream of air from an electric fan. So long as the skin temperature does not fall 3° C. below the general body temperature, no discomfort is experienced. One to one and a half hours will be required for restoration of normal temperature depending on the obesity of the patient.

The general reaction of a patient during this form of therapy is comparable to that observed in any patient with a high fever. Chart 1 presents typical temperature, pulse, and respiration curves. (The vaginal temperature, as measured by a mercury thermometer is consistently 0.1° C or 0.2° C. below the rectal temperature.) The blood pressure at first shows a slight rise from 10 to 20 mm. but after the temperature has reached its maximum, a steady gradual drop occurs to 80/40 or 70/40. Should the systolic pressure fall to a lower level for more than a few minutes and not respond to the administration of caffeine, the treatment should be terminated. Occasionally, the ex-

citable patient may show some degree of delirium. An occasional patient may also develop herpes about the lips. There is a marked loss of weight during the treatment at times amounting to as much as four or five kilos, which is usually regained in from seven to ten days. The vaginal discharge is increased to a marked degree, as much as 200 c.c. resulting during the course of treatment. In three of our patients slight superficial burns occurred from contact with the electrodes.

An important effect of the treatment is a marked leucocytosis, the leucocyte count averaging 15,000. Associated with this is a very active phagocytosis which can be demonstrated by vaginal smears taken from time to time during the treatment. This stimulation of the normal defense mechanism is undoubtedly an important factor in the results obtained.

On account of the general effect on the patient, this line of therapy is distinctly contraindicated in the presence of vascular or respiratory disease and also in alcoholics.

PRESENTATION OF RESULTS

The first patients to be subjected to this line of therapy were a small number of young women who presented evidence of a gonorrheal infection of the lower birth canal only, and in whom as far as could be ascertained there was no extension of the infection beyond the cervix. None of these patients were acutely ill, but they all presented local evidence of infection, and repeated bacteriologic examinations revealed the presence of gonococci in material obtained from the cervix or urethra. These patients had been hospitalized on account of the fact that they were inmates of a shelter for delinquent girls and were considered a menace to the other inmates.

There were six patients in this group. Five had received local treatments consisting of the application of strong (20 per cent) mercurochrome or tincture of metaphen or both to cervix, urethra, and vagina for a length of time varying from eighteen days to several weeks. In spite of these prolonged treatments, repeated bacteriologic examinations revealed gonococci to be present. They were then subjected to general hyperthermia. One of this group was so treated without having had any local treatment previously.

Following treatment by general hyperthermia, daily smears were taken from the cervix and urethra, also occasional cultures during the patients' stay in the hospital. After leaving the hospital, they were followed for varying lengths of time, repeated bacteriologic examinations being made particularly postmenstrual when possible.

In two of these patients the follow-up is admittedly of too short a duration, but this was unfortunately unavoidable. In three of the six patients treatment by general hyperthermia for five hours at 41.5° C. resulted in immediate and complete disappearance of gonococci from the cervix and urethra. In three others gonococci could still be found,

so the treatment was repeated several days later. In two instances, the second treatment resulted in complete disappearance of the organisms, but in the third, organisms could still be found after the second treatment. This one must therefore be regarded as a failure. In trying to ascertain the reason for this failure, it was found that a culture of the organisms obtained from this patient when placed in the water-bath required seven hours at 41.5° C. before it was killed, the failure obviously being due to the fact that she was infected with a strain of organisms presenting greater heat resistance.

However, following the general hyperthermia, a short period of local treatment with tincture of metaphen resulted in negative smears. This fact suggests that the organisms may at least have been considerably attenuated by the treatment.

A brief outline of the patients in this group may be presented as follows:

Case 1.—(Unit No. 44217) Local treatments for eight weeks with no result. General hyperthermia for five hours at 41.5° C., gonococci still present. General hyperthermia repeated ten days later for five hours at 41.5° C. Repeated examinations during next eight weeks revealed no gonococci.

Case 2.—(Unit No. 55373) Excision of Bartholin's gland and local treatments for eighteen days, smear still +. General hyperthermia for five hours at 41.5° C. Repeated examination in the next four weeks failed to show gonococci. The menstrual period which was due to occur during this patient's stay in the hospital failed to appear and at present she is approximately four months' pregnant. Therapy was apparently carried out on her during the very early stages of her pregnancy without harmful results. Subsequent examinations during four months after treatment failed to show gonococci.

Case 3.—(Unit No. 44540) Local treatments for twenty-six days without effect. General hyperthermia for five hours at 41.5° C. Smear next day +; succeeding ones negative. General hyperthermia for five hours at 41.5° C. repeated twelve days later. No gonococci demonstrated during the next eight weeks.

Case 4.—(Unit No. 55066) Local treatments for eighteen days without effect. General hyperthermia for five hours at 41.5° C. No gonococci found during the next week. Result apparently good, but the follow-up is defective.

Case 5.—(Unit No. 16972) No local treatments, gonococci present. General hyperthermia for five hours at 41.5° C. No gonococci found during the next five days. Result apparently good but the follow-up is too short.

Case 6.—(Unit No. 23475) Local treatments for twenty-six days with no effect. General hyperthermia for five hours at 41.5° C. Smears still +. General hyperthermia for five hours at 41.5° C. repeated fifteen days later (postmenstrual). Smears still +. Failure due to the fact that this was a more resistant strain, requiring seven hours at this temperature to cause its death. Smears, however, became negative after four local treatments with tincture of metaphen—apparently the organisms were at least attenuated.

Encouraged by the results obtained in this group of patients, a small number of women who showed definite evidence of tubal involvement of an acute or subacute type in addition to signs of infection in the lower birth canal were subjected to this type of therapy.

All of these had had local and palliative treatment prior to being subjected to general hyperthermia for a varying length of time. Following this each was subjected to a single general hyperthermia treatment at 41.5° C. for five hours except in two instances when it was reduced to three hours, once on account of the violence of the patient and once on account of the poor reaction of the patient. There were 9 patients in this group, all being hospital cases. In 6 of them the results obtained left little to be desired, in 2 the result can only be regarded as partially successful, while in another it resulted in failure. The failure may be fairly attributed to a too short duration of treatment. The important features in this group of patients may be briefly outlined as follows:

CASE 7.—(Unit No. 13766) Puerperal exacerbation of gonorrheal infection with tubal involvement. Local and palliative treatment for twenty days, symptomatically improved but gonococci still present. General hyperthermia resorted to. Followed at intervals for four months. No gonococci found and no gross evidence of pelvic disease.

CASE 8.—(Unit No. 52099) Evident tubal involvement but no grossly palpable masses. Local and palliative treatment for two weeks with some improvement but gonococci still present. General hyperthermia. Followed for four months. No gonococci found, slight residual thickness of one tube.

CASE 9.—(Unit No. 54995) Bilaterally palpable tubes and mass on one side 5 by 6 cm. Local and palliative treatments for six weeks. Gonococci still present, and little if any change in the pelvic findings. General hyperthermia. Followed for six weeks. No symptoms. No gonococci found, and no palpable masses at the end of that time.

CASE 10.—(Unit No. 55196) Evidence of tubal involvement but no grossly palpable masses. Local and palliative treatment for eighteen days. Improved but gonococci still present. General hyperthermia. Followed for one month. No gonococci found, no palpable abnormalities of tubes.

CASE 11.—(Unit No. 57871) Bilateral tuboovarian masses. Local and palliative treatments for five weeks. Improved but gonococci still present and little change in the size of the masses. General hyperthermia. One week later no symptoms and masses barely palpable, no gonococci found. Followed for a month. No gonococci found. Pelvic findings negative at the end of that time.

CASE 12.—(Unit No. 26290) Puerperal exacerbation of gonorrheal infection with acute tubal involvement. Local and palliative treatment for five weeks. Improved but gonococci still present. General hyperthermia. Followed for ten days. No gonococci found. Pelvic findings negative. Result apparently good but the follow-up is too short.

CASE 13.—(Unit No. 49940) Bilateral tuboovarian masses. Febrile for twenty-four days. Local and palliative treatment for seven weeks. General hyperthermia. Followed for one month. No gonococci found. Symptoms relieved but masses still present. This is only considered a partial success. Seen later gonococci found. Evidence obtainable points to a reinfection by exposure.

CASE 14.—(Unit No. 48415) Tubal involvement but no grossly palpable masses. Local and palliative treatment for six weeks. General hyperthermia for three hours only. Patient quite violent. Followed for four weeks. No gonococci found

in spite of incomplete treatment. Three months later gonococci present. Pelvic abscess drained. Definite evidence of reinfection obtained.

CASE 15.—(Unit No. 40872) First had a puerperal flare-up of a gonorrheal infection. Palliative treatment, improved. Several readmissions on account of reinfection during the next fifteen months. At present large bilateral tuboovarian masses and gonococci present. General hyperthermia for three hours only on account of poor reaction of patient with marked drop in blood pressure and unusual acceleration of pulse rate. Masses unchanged, gonococci still found. Failure on account of too short a period of treatment. This patient will require surgical treatment.

In two patients in our series the pelvic infection was complicated by the presence of a gonorrheal arthritis. In each instance the symptoms subsided entirely after they were subjected to general hyperthermia, one patient receiving two treatments while only a single treatment was administered to the other. The salient features in these two patients may be briefly outlined as follows:

CASE 16.—(Unit No. 45292) Showed the stigmata of a gonorrheal infection on pelvic examination but no organisms were found. Gonorrheal arthritis of left ankle and right wrist present. General hyperthermia for five hours at 41.5° C. followed by improvement. Repeated eighteen days later followed by rapid disappearance of symptoms. One smear +, immediately after treatment all others negative. Became pregnant a few weeks after last treatment. Spontaneous delivery, no exacerbation in puerperium, and repeated examinations failed to show gonococci.

CASE 17.—(Unit No. 55134) Active gonorrheal infection of lower birth canal and associated gonorrheal arthritis of right wrist. Excision of Bartholin's gland. Local and palliative treatment for twenty-six days. Gonococci still present. General hyperthermia. Followed for one week. Rapid improvement of arthritis. No gonococci present. Gonococci subsequently found. Reinfection admitted.

In only three cases presenting chronic salpingitis or showing the residual effects of an old acute process was this type of therapy employed. Two were quite evidently benefited by it, while the third showed no improvement in symptoms whatsoever. The results obtained in these patients may be briefly outlined as follows:

CASE 18.—(Unit No. 58973) Presented the stigmata of gonorrheal infection but no organisms found. Small bilateral tuboovarian masses present, considerable lower abdominal pain. Palliative treatment for sixteen days, not improved. General hyperthermia for five hours at 41.5° C. Five days later no pain, some decrease in size of masses. Two weeks later lateral masses almost entirely gone, no symptoms, evidence of adherent appendages.

CASE 19.—(Unit No. 59699) Stigmata of gonorrheal infection but no organisms found. Pelvic pain. Uterus retroverted and adherent, small unilateral mass. No palliative treatment. General hyperthermia for five hours at 41.5° C. Five days later pain relieved. Week later, greater motility of pelvic organs on examination.

CASE 20.—(Unit No. 48610) Stigmata of gonorrheal infection but no organisms found. Persistent right-sided pain. Thickening found in both tubes and a small right-sided mass. Long course of palliative treatment in out-patient department. General hyperthermia for five hours at 41.5° C. Symptoms not relieved. Operation six weeks later. Cystic right ovary enmeshed in the most filmy of adhesions about

right tube. Left appendages normal. Right salpingo-oophorectomy and removal of normal appendix, followed by smooth convalescence and relief of symptoms.

This case is of particular interest on account of the opportunity permitted to examine the pelvic structures some time after treatment. The adhesions, though fairly numerous, were of the most filmy type. Microscopically the tubal mucosa appeared normal. Whether the adhesions were more dense before treatment or not, it is impossible to say.

SUMMARY AND CONCLUSIONS

The results obtained in twenty women who presented various forms of gonorrheal infection and who were treated by general hyperthermia are herewith presented. The results on the whole have been satisfactory and generally resulted in a rapid disappearance of symptoms as well as a disappearance of the organisms. The failures in this series have been due to either deficient treatment, or to the fact that the particular strain of gonococcus encountered was more resistant to heat than the average strain of organisms is. A point we would emphasize is that even in the failures we have at no time observed any evidence which would point to an exacerbation of the condition present, but rather the reverse held true.

This series is much too small to permit of any far reaching conclusions being drawn, and we do not recommend this procedure at present as a routine procedure in the treatment of gonorrheal infections. Rather, we present this preliminary report as a clinical demonstration of the fact, established in the laboratory, that the usual strains of gonococci can apparently be destroyed in the body after exposure to high temperature for definite lengths of time. For clinical application the temperature and duration of therapy must be such as to be safely tolerated by the patient.

Encouraged by the results obtained in this small series, we propose to continue this work and hope to develop a technic which will be simpler and more easily tolerated by the patient. Further observations should also permit us to decide more accurately the type of pelvic lesion and the stage of the disease which will be most amenable to this form of therapy. No doubt some women will be found to be infected with strains of organisms which are unusually resistant to heat, and in whom therefore this line of therapy will prove to be impracticable.

THE PRESENT POSITION OF VERSION AND EXTRACTION*

An Analysis of the Shifting Incidence of Version and Extraction, High Forceps, and Cesarean Section at the Michael Reese Hospital

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OPERATIVE obstetrics is steadily gaining recognition as a form of specialization essential to the practice of sound obstetrics. The successful termination of a delivery with due consideration for the maximum safety of mother and fetus depends upon a variety of factors, an intimate knowledge of the anatomic and clinical background of the patient by prenatal survey, a true evaluation of the problems which may arise in the course of labor, and the intelligent application under proper aseptic conditions of such operative procedures as may be indicated.

In recent years there has been a noticeable increase in the incidence of cesarean section in the majority of the obstetric clinics of this country. During the same period, version and extraction has, in the main, shown a definite decrease, although in some few clinics the operation has increased in popularity and frequency. Delivery by high forceps has everywhere shown a decrease.

A cursory survey of the incidence of these three operations in the Michael Reese Hospital during the past ten years revealed a decided increase in the number of cesarean sections and a 50 per cent reduction in the incidence of both version and extraction and high forceps. Convinced of the value of version and extraction and its extreme suitability under appropriate conditions, a critical analysis of the results obtained by this operation was undertaken and compared with the results obtained by high forceps and by cesarean section.

The period studied was the ten years from 1922 to 1931 inclusive, during which time, 15,136 women were confined at the Michael Reese Hospital. This included all service patients and all private patients of staff men. Of these, 156 or 1.03 per cent were delivered by version and extraction. From the New York Lying-In, Markoe reports an incidence of 2.23 per cent in 60,000 consecutive deliveries. Krukenberg reports 1.6 per cent from the Bonn clinic for the period 1912 to 1929. Good from the Boston City Lying-In Hospital reports 3.24 per cent over a ten-year period ending with 1929. Greer gives 3 per cent for a six-year period with 4668 deliveries at the Evanston Hospital. Stander reports 2 per cent incidence of version and extraction at the Johns Hopkins Hospital, and Polak reports 5 per cent incidence of version and extraction at the Long Island Hospital during 1920-30. Willets gives the incidence as 3.36 per cent in Grand Rapids.

*Read at the Fifty-Seventh Annual Meeting of the American Gynecological Society, May 30 to June 1, 1932, at Quebec, Canada.

TABLE I. MICHAEL REESE HOSPITAL, 1922-1931

	VERSION AND EXTRACTION	HIGH FORCEPS	CESAREAN SECTION
1922	1.17 per cent	1.17 per cent	0.85 per cent
1923	1.52	1.66	0.58
1924	1.56	1.40	0.85
1925	1.70	1.86	1.24
1926	1.09	0.75	1.03
1927	0.55	0.85	3.40
1928	0.49	0.62	3.08
1929	0.77	0.33	3.85
1930	1.00	0.21	4.23
1931	0.82	0.27	4.36
Total	156—1.03 per cent	148—0.97 per cent	381—2.52 per cent

During this same period 148 or 0.97 per cent were delivered by high forceps and 381 or 2.52 per cent by cesarean section.

The trend in the selection of these operations is well shown by a comparison of the first and second five-year periods. It will be observed that the incidence of version and extraction dropped 50 per cent, from

	VERSION AND EXTRACTION	HIGH FORCEPS	CESAREAN SECTION
1922-26	94—1.40 per cent	91—1.36 per cent	61—0.91 per cent
1927-31	62—0.73 per cent	57—0.68 per cent	320—3.78 per cent

1.40 per cent to 0.73 per cent. The same is true of delivery by high forceps, the incidence dropping from 1.36 per cent to 0.68 per cent. Cesarean section on the other hand increased 420 per cent from 0.91 per cent to 3.78 per cent. The total number of versions and extractions for the ten-year period was 156 and the total number of high forceps was 148. The total number of cesarean sections was 381. The 50 per cent drop in version and extraction and in high forceps and the fourfold increase in cesarean section represents not merely a shift in indications and in the replacement of version and extraction and high forceps by cesarean section but also an actual increase in the number of cesarean sections based on a widening of the indications for this latter operation.

Parity.—The parity of the patients delivered by version and extraction ranged from pari i to para xii. Of these 42 were primipara, 38 were para ii, 24 were para iii, 17 were para iv, 5 were para v, and 21 were para vi to xi.

There is a widespread feeling that the primipara is poorly adapted for the successful performance of this operation because of the nulliparous integrity and resistance of the lower birth canal. Potter has shown conclusively that the pelvic floor can, under surgical anesthesia, be so completely ironed out in most instances as to offer no greater resistance to the advance of the fetus than does the birth canal of the multipara. This preparatory overstretching of the pelvic musculature and fascia must be carried out gently but over a sufficiently long period of time to obtain the desired result. Episiotomy is no substitute while

perineotomy sufficiently deep to lay open the birth canal involves an extensive and unnecessary trauma to the patient.

Duration of Pregnancy.—The duration of pregnancy varied from twenty-eight to forty-four weeks among the 156 patients under consideration. Of these 109 were at term, 14 were postmature and the remainder were premature.

28 weeks	1	38 weeks	10
30 weeks	2	Term	109
32 weeks	5	42 weeks	4
34 weeks	6	44 weeks	10
36 weeks	9		

Postmaturity is not in itself a contraindication for version and extraction. The feasibility of the procedure depends upon the existence or degree of disproportion and can be determined by the Mueller or the Hillis maneuver.

State of the Membranes.—Analysis of the state of the membranes revealed that they were intact in 75 patients, recently ruptured in 51 patients, ruptured one to four hours in 11 patients, five to twelve hours in 8 patients, and over twelve hours in 11 patients.

The facility with which the fetus can be manipulated within the uterine cavity during labor depends upon the degree of anesthesia and upon the amount of liquor amnii present at the time of version. Version is among the easiest of the intrauterine operations when these conditions are satisfactorily fulfilled. It can still be carried out under deep surgical anesthesia after considerable liquor amnii has been lost. Version should not be undertaken if overstretching of the lower uterine segment and moulding of the uterus around the fetus indicate a complete loss of liquor amnii with the consequent increased risk of rupture of the uterus. This explains the apparent anomaly that version sometimes fails when undertaken only one or two hours after rupture of the membranes and may succeed twenty-four or more hours following rupture in other patients.

Cervix.—The cervix was completely effaced in 142 patients and incompletely effaced in 14. Dilatation of the cervix had reached 10 cm. in 94 patients and was incomplete in 62 patients. The treatment instituted consisted in manual dilatation of the cervix in 24, dilatation by bag insertion in 25 and Duehrrsen's incisions in 8 patients. Fourteen women sustained cervical lacerations of sufficient degree to require repair.

While it might be anticipated that more injuries of the cervix would have occurred in a group in which there was so large a proportion of incomplete cervical dilatation together with 49 artificial dilatations, it must be remembered that 33 patients gave birth to premature infants.

Manual dilatation	24
Bag dilatation	25
Duehrrsen's incision	8
Lacerations	14

The dictum that version and extraction may not be attempted except in the presence of a fully dilated or dilatable cervix carries with it the implication that the qualified obstetrician must be able to determine the safety and feasibility of artificially producing complete dilatation. Manual dilatation is applicable to the thin cervix, while for the thick cervix the choice must rest between the bag for slow dilatation and Duehrrsen's incisions for rapid dilatation.

Perineal Injuries.—Twenty-one patients sustained first degree lacerations of the perineum, 29 a second degree laceration, and 6 a third degree or complete laceration. Of these latter, 4 occurred in multiparae and 2 in primiparae. All 6 were repaired at the time of injury and all 6 healed with good functional results. Episiotomy was done 21 times, 15 of these patients were primiparae, 14 being at term. There were 33 primiparae at or past term. Five were delivered without injury to the perineal body, 5 sustained a first degree laceration, 7 a second degree laceration, and 2 a third degree laceration. In the remaining 14, episiotomy was done.

It is an open question whether these patients would have reached a better end-result by routine episiotomy, by vaginal ironing out, or by the selective methods just described. As previously indicated, skillful ironing out of the vagina and perineum on suitably selected patients provides the best means of preserving the integrity of the vagina and of the perineal body when a version and extraction is to be performed.

Anesthesia.—Anesthesia was employed in every instance but one. This patient was a sixteen-year-old primipara at term who entered the hospital in convulsions and died almost immediately after admission. A version and extraction done three minutes after death had occurred, resulted in a stillbirth. Open mask ether was the anesthetic used for 98 patients. Ethylene-oxygen and ether were used 45 times, ethylene-oxygen alone twice, nitrous oxide-oxygen and ether 6 times and nitrous oxide-oxygen 4 times.

It should be noted that ether anesthesia, either alone or in combination, was used for 150 of the 156 patients in this series. Complete relaxation is the essential objective for the safe performance of version and extraction. The advantage of a combination of ethylene-oxygen with ether lies first in the ease and speed of induction of anesthesia by the ethylene-oxygen and secondly in the limitation of the use of the ether to the time of the actual performance of the operation.

Indications.—Version and extraction was performed 42 times for cephalic malpositions, relative disproportion and failure of engagement of the fetal head. The operation was undertaken 17 times after high forceps had failed, 16 times for failing fetal heart tones, 16 times for prolapse of the cord, 16 times for transverse presentations, and 16 times for the delivery of a second twin. Fourteen patients with placenta previa were delivered by version and extraction, 8 of these were of the marginal type, 4 of the lateral type, and 2 of the central type. Five other

patients were delivered because of premature separation of the placenta. The indications in the remaining 14 patients were face presentation 6 times, toxemia of pregnancy or eclampsia 6 times and no diagnosis in 2 instances.

Version and extraction as employed at the Michael Reese Hospital is an operative procedure based on a specific pathologic indication rather than a method of termination of labor without indication. The indications as listed above are self-explanatory in justification of the operation. One exception must be clarified. Placenta previa centralis is coming more and more to be regarded as an indication for cesarean section, but there is still room for debate as the two instances recorded above demonstrate. The one patient was a para vi in the thirty-fourth week of pregnancy and the other a para ii in the thirtieth week of her pregnancy. In each patient vaginal delivery sufficed to terminate the pregnancy and the parturient was spared the additional risk inherent in any cesarean section, especially since the degree of prematurity did not warrant this increased risk for the mother.

Maternal Mortality.—In this series there were 5 maternal deaths, 3.24 per cent.

1. The first death occurred in 1925. The patient was a twenty-one-year-old para iii, who had been operated upon two days before delivery at term for a right-sided acute mastoiditis following otitis media. Version and extraction was done following manual dilatation of the cervix for failing heart tones. The operation was not a difficult one and the fetus weighing 3460 gm. survived. Death occurred twenty-four hours following delivery and was apparently due to shock. Autopsy revealed a rupture of the uterus extending into the right broad ligament with severe hemorrhage. The concealed hemorrhage extended into the broad ligament and into the peritoneal cavity.

2. The second death occurred in 1926 in a twenty-six-year-old para iv who was bleeding moderately from a placenta previa lateralis. The pregnancy was at term, labor induced by rupture of the membranes and bag insertion. A version and extraction was done when cervical dilatation was complete. The fetus survived and weighed 5685 gm. The placenta was removed manually, the uterus was not packed and there was a severe and continued postpartum hemorrhage which resulted in death twenty hours following delivery.

3. The third death was that of a sixteen-year-old primipara who entered the hospital at term in 1927. She had had no prenatal care and had had several convulsions before admission. She entered the hospital in status convulsus and died ten minutes after admission. Examination showed her to have complete effacement and dilatation. A version and extraction was done three minutes after death had occurred. The fetus was stillborn.

4. The fourth death was that of a forty-two-year-old para iii who entered the hospital in her thirty-sixth week of pregnancy in a moribund state from a profuse vaginal hemorrhage. The cervix was 4 cm. dilated, completely effaced, and the membranes were intact. The cervix was dilated manually, a version and extraction done. The fetus was stillborn. The placenta was removed manually and the uterine cavity packed. Death occurred ten minutes following delivery in spite of all attempts at fluid replacement. This death occurred in 1930.

5. The fifth death occurred in a twenty-eight-year-old para i (1930) at term. There was a bilateral bronchopneumonia present for two days previous to delivery,

a caseous tuberculosis of one lung and aortic insufficiency. The cervix was completely effaced and dilated when the fetal heart tones became irregular. An immediate version and extraction was done and the fetus which weighed 3770 gm. survived. Death occurred one hour following delivery. The immediate cause of death was pulmonary edema with dilatation of the right heart superimposed on the bilateral bronchopneumonia.

Of these 5 deaths, one, that of the first patient who died following a rupture of the uterus, was directly chargeable to the operation. The second death can also be charged to the type of delivery, but in none of the others did the method of delivery play a rôle in the death of the patient. The corrected mortality for the 156 patients delivered by version and extraction is therefore 1.30 per cent.

During the same ten-year period, high forceps were used 148 times. Delivery was accomplished in 131 women and failed in 17 who were then delivered by version and extraction. This incidence of 11.5 per cent of unsuccessful attempts at delivery by high forceps suggests that the operators involved, having set the indications for high forceps delivery, were discreet enough to switch from a hopeless procedure to one that held out greater hope of survival for the fetus. Actually 16 of these 17 babies survived.

There was one maternal death in the series of high forceps deliveries, a gross mortality of 0.67 per cent. This patient succumbed to a bilateral bronchopneumonia forty-eight hours following delivery. The corrected mortality is therefore 0.0.

During this same decade there were 381 deliveries by abdominal cesarean section. There were 9 maternal deaths, a gross mortality of 2.36 per cent. One patient was operated upon while moribund from influenza pneumonia and death occurred during the operation. The fetus which was near term, survived. The corrected mortality was therefore 2.10 per cent. The remaining 8 deaths were due to postoperative infections in three instances, once to eclampsia, once to hemorrhage following premature separation of the placenta, once to myocarditis, once to uremia, and once to hemorrhage following placenta previa.

During the same decade, the gross maternal mortality among the 15,136 patients delivered at the Michael Reese Hospital was 37 deaths or 0.24 per cent.

Maternal Morbidity.—Table II offers a comparison of the causes of maternal morbidity in the three types of operations under consideration. Infection of various origins occurred in approximately one-third of all the patients subjected to cesarean section. This is double the frequency with which infection occurred following high forceps and two and one-half times the incidence of infection occurring after version and extraction. It should be noted further that some degree of ileus occurred in approximately 10 per cent of all cesarean section patients, while shock and postpartum hemorrhage were more prominent complications in the other types of operations. Complications, either postoperative or inci-

dental occurred in one out of every 5 patients delivered by version and extraction, in one out of every 4 delivered by high forceps, and in one out of every 2 delivered by cesarean section.

The annual average morbidity of all patients delivered at the Michael Reese Hospital is 11 per cent. The standard of febrile morbidity is the generally accepted one of temperature above 100.4° F. on two successive days or 101° F. once, excluding the first twenty-four hours postpartum. Thus far vaginal antisepsis has not been used except in a very small percentage of deliveries.

TABLE II. MATERNAL MORTALITY AND MORBIDITY

	VERSION AND EXTRACTION	HIGH FORCEPS	CESAREAN SECTION
Fever of unknown origin	5.30 per cent	9.46 per cent	7.08 per cent
Foul Lochia	3.20	2.88	13.91
Sapremia	1.28	0.67	
Wound infection with or without suppuration			8.92
Puerperal sepsis	0.64	2.01	0.78
Thrombophlebitis	2.56	1.34	1.83
Total Infections	12.98	16.36	32.52
Shock	1.92	2.88	
Postpartum hemorrhage	4.49	4.69	0.26
Ileus	0.64	0.00	9.76
Pyelitis	0.64	0.67	5.77
Bronchitis	0.64	0.67	0.79
Pneumonia	0.00	0.00	0.79
Acute gastric dilatation	0.00	0.00	1.05
Massive collapse lung	0.00	0.00	0.26
Evisceration	0.00	0.00	0.79
Fistula	0.00	0.00	0.26
Total Complications	21.23 per cent	25.27 per cent	52.75 per cent
Mortality: Gross	3.24 per cent	0.67 per cent	2.36 per cent
Corrected	1.30 per cent	0.00 per cent	2.10 per cent

Study of the sources of fever revealed a considerable group classified under the heading of "fever of unknown origin." This group represented for the most part, patients in whom enough fever occurred to require inclusion under the rigid classification of morbidity. The short duration of the fever in these instances did not permit of a source diagnosis.

The incidence of foul lochia or foul lochia with fever (sapremia) 13.91 per cent, following cesarean section seems higher than it should be. The uterus is always sutured with catgut, care being taken to place the deeper row of sutures down to but not including the uterine mucosa. The foul lochia should not therefore be charged to dissolution of the catgut but rather to mild localized infection.

Fetal Mortality.—As might have been anticipated, the fetal mortality following cesarean section was the lowest in the three types of operation,

3.38 per cent gross mortality and 1.04 per cent corrected mortality. The gross fetal mortality following high forceps was 8.13 per cent and the corrected fetal mortality was 7.41 per cent. Following version and extraction the gross fetal mortality was 17.28 per cent and the corrected mortality was 10.24 per cent. In connection with the high rate of fetal death after version and extraction, it must be borne in mind that this figure represents the end-results in patients with various types of pathology in whom version and extraction was frequently a desperate life-saving measure rather than an operation of choice. Moreover, 7 of these babies were definitely premature. Each of the 7 weighed less than 2200 gm.

SUMMARY

Version and extraction was done 156 times in 15,136 deliveries, 1.03 per cent during the decade 1922-1931. The frequency of the operation dropped 50 per cent during the second five-year period. During the same ten years, high forceps were used 148 times, 0.97 per cent, with a similar 50 per cent drop in the second five-year period. The total number of cesarean sections was 381, 2.52 per cent, with a fourfold increase in the second five-year period. These figures represent not merely a shift in indications and in the replacement of version and extraction and high forceps by cesarean section but also an actual increase in the percentage of cesarean sections based on a widening of the indications for this latter operation.

The maternal mortality following delivery by version and extraction was 1.30 per cent, by high forceps was zero and by cesarean section was 2.10 per cent. The incidence of infection following version and extraction was 12.98 per cent, following high forceps was 16.36 per cent, and following cesarean section was 32 per cent. Complications both operative and incidental occurred in 21.31 per cent following version and extraction, in 25.27 per cent following high forceps and in 52.75 per cent following cesarean section. Fetal deaths occurred in 12.82 per cent of the deliveries by version and extraction, in 7.41 per cent of those by high forceps and in 1.04 per cent of the deliveries by cesarean section.

CONCLUSIONS

1. The well recognized dangers inherent in delivery by high forceps, justify the 50 per cent diminution in the frequency of this type of delivery.

2. The similar decrease in the frequency of delivery by version and extraction in this series is definitely not justified.

3. The margin of safety for the parturient following version and extraction is much greater than that offered by cesarean section.

4. Cesarean section must not become a substitute for version and extraction.

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THE PROPHYLACTIC TREATMENT OF THYROID DYSFUNCTION AND THE IMPORTANCE OF BASAL METABOLISM STUDIES IN OBSTETRICS AND GYNECOLOGY*

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THE various glands of internal secretion have been the subjects of both laboratory and clinical investigation for many years, but organotherapy when applied to patients suffering from some type of gland dysfunction continues to be more or less unsatisfactory. The outstanding exception is the group of patients with thyroid dysfunction of the deficiency type who are greatly benefited from the administration of desiccated thyroid.

Interesting experimental data are being reported from the administration of certain gland products or hormones, which indicate that progress is being made, but thus far the necessary dosage is much too expensive for the average patient since the results are of a temporary nature and the cost of the preparations too great for long continued usage. It is, therefore, fortunate that so many patients with endocrine dysfunctions are benefited from the use of desiccated thyroid which is the least expensive endocrine preparation owing to the large amount of animal material suitable for its manufacture.

The relationship of the thyroid to the sex glands as evidenced by thyroid enlargement with menstruation, puberty, pregnancy, and the menopause as well as the increased incidence of goiter in the female was recognized by the ancients. The nature of this interrelationship still remains a problem for future investigations. Both clinical and laboratory investigations suggest a close relationship between the function of the thyroid and most other glands of internal secretions. It also seems probable from a purely theoretical point of view that measures directed toward the development of a normal thyroid in the fetus may prove to be of value in securing a more normal development of other glands of internal secretion.

Fortunately, the epoch making observations and clinical experiments of David Marine have made possible an almost complete elimination of thyroid insufficiencies of the developmental type. In 1917 he reported that there is always some decrease in the iodine content of the thyroid during pregnancy and he urged the administration of iodine to prevent the hypertrophy of the thyroid which occurs so commonly among pregnant women who live in goiter areas. More recent observations of Marine and others indicate that simple goiter of the congenital type may be eliminated in a single generation, provided the mothers have proper medication during the period of pregnancy. However, it seems

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probable that it may take two or three generations of goiter prevention to eliminate the hereditary factors associated with cretinism.

Marine and Kimball after making an extensive study of the school children in Detroit and Cleveland (1924-25) started a definite program for goiter prevention in these two cities. Their studies indicated that in 1924 the children in the regular schools of Detroit showed a total goiter incidence of 36 per cent while those in Cleveland showed 34 per cent. The use of iodine as a preventive measure was begun in 1925 and has been continued although in the spring of 1926 a number of physicians opposed its use arguing that the general use of iodized salt might increase the incidence of hyperthyroidism. Detroit school physicians during the school year 1930-31 examined more than 100,000 children from the first grade through high school and reported that only 2.1 per cent showed any enlargement of the thyroid. Practically all of these enlargements were small discrete adenomas of the congenital type. Kimball and Marine examined 5,075 children in the special schools of Detroit during the same period and found a total incidence of 12 per cent with some evidence of goiter, but 97 per cent of these were only discrete adenomas or a persistent thyroglossal stalk (congenital goiter) with the remainder of the gland normal.

In Kimball's recent paper on goiter (1931) he effectively answers the arguments of those who feared that the general use of iodized salt would increase the incidence of toxic goiter by showing from the records of the Grace Hospital and the Henry Ford Hospital of Detroit that the number of goiter operations have been greatly reduced during the years since iodine in iodized salt has been used throughout Michigan.

In 1919, following the early advice of Marine, I began the administration of iodine during pregnancy to every woman who showed any evidence of thyroid hypertrophy. However, the presence of congenital goiter was observed in the newborn of some women who, not having any evidence of thyroid enlargement, did not take iodine during pregnancy. One of these mothers developed a slight hypertrophy during her second pregnancy and four months after delivery returned to the office with typical symptoms of hyperthyroidism. Her basal metabolism rate at that time was plus 47.8 per cent. Under medical treatment with rest in bed, iodine and sedatives, the rate returned to normal within three months and she later developed symptoms of a mild hypothyroidism.

Another patient who has never had any evidence of thyroid enlargement developed a typical myxedema in 1925 within four months after the birth of her fourth baby. At that time her basal metabolism rate was minus 19.7 per cent and she has required from 3 to 5 gr. of desiccated thyroid per day ever since it was started in November, 1925. All four of her children show evidence of endocrine dysfunction, 2 have enlarged thyroids and 3 of them have definite evidence of hypothyroidism. It is interesting to note that this woman's mother also developed a myxedema at the menopause without any evidence of thyroid hypertrophy and because of this discrepancy in the physical findings suffered from the condition for several years before desiccated thyroid was tried. She has used approximately 5 gr. of desiccated thyroid per

day for more than twenty-three years. If time permitted other cases might be cited to show that myxedema in the mother as well as cretinism in the infant may develop without any previous evidence of thyroid enlargement or disease.

It is evident from observations of patients suffering from thyroid dysfunction that all women living in goiter areas must have careful medication during pregnancy and lactation. The routine administration of small doses of iodine to every pregnant woman is advocated in the belief that it will lessen to a great extent the incidence of congenital goiter, and that it will probably reduce the incidence of cretinism and other evidence of thyroid dysfunction. There is no evidence that the use of small amounts of iodine has been harmful even for the patients with adenomatous goiter or those with a definite hyperthyroidism. However, even if we assume that some slight harmful effect might occasionally be seen in the pregnant woman suffering from a preexisting hyperthyroidism, the iodine still should be administered as a means of protecting the developing fetus.

The regular use of iodized salt has greatly reduced the incidence of congenital goiter in the sections where it has been tried, however, it seems probable that the amount of iodine obtained from it may not be sufficient for the pregnant woman living in a goiter area. It is probably safer to give additional iodine in the form of iodostarine, one tablet every other day, or five drops of the syrup of hydriodic acid every other day. It is also believed that all patients with definite hypothyroidism should have desiccated thyroid throughout the period of pregnancy and lactation as an additional means of protecting the infant. Basal metabolism observations are important, being the only test which enables us to recognize the milder degrees of hypothyroidism. Combined with clinical observations such as the pulse rate, body weight, temperature, bowel movements, perspiration and growth of hair, basal metabolism observations are very important in regulating the dose of desiccated thyroid.

In Pemberton Meadows, B. C., it has been found impossible to rear domestic animals unless iodine is given to the mother during pregnancy and to the young after birth. In the Great Lakes area the incidence of congenital myxedema in domestic animals was high until prophylactic treatment with iodine was introduced. Marine has repeatedly demonstrated the ease with which endemic cretinism in animals may be cured by the administration of iodine or desiccated thyroid if such treatment is started within a few days after birth. His observations indicate that the severest effects of thyroid insufficiency occur during fetal life when irreparable damage may be done to the nervous system if the thyroid insufficiency is great enough. In view of the interrelationship which various observers have shown to exist between the thyroid and the other glands of internal secretion, it is probable that a thyroid insufficiency

of a severe degree in a mother may affect the fetal development of all glands of internal secretion. It has been stated that the pituitary is usually enlarged in patients with simple goiter, cretinism and after thyroidectomy.

Thus far we have emphasized the importance of prophylactic treatment of the thyroid during pregnancy and the years of development. While this is believed to be of paramount importance, the gynecologist is confronted with a variety of problems which are related to the thyroid as well as other glands of internal secretion. It has been recognized for years that a certain type of uterine hemorrhage is associated with hypothyroidism and that it may be corrected by the administration of desiccated thyroid. Litzenberg, Meaker and others have found that thyroid dysfunction may be an important factor in sterility. It is, therefore, evident that in our specialty basal metabolism studies are of great importance and it is believed that they should be obtained more frequently in the study of obstetric and gynecologic patients.

Roth has recently pointed out that the present day clinician guided by a broad survey of metabolic disturbances, their causes and effects, no longer focuses his attention solely on the thyroid or on any other parts of the controlling mechanism of metabolism, but recognizes that the body machine, the rate of activity of which is merely governed by this mechanism, is susceptible to many types of defects or pathologic conditions which are probably more often the initial cause of metabolic morbidity than thyroid, adrenal or pituitary dysfunction. He lists the following conditions in which a basal metabolism study is now recognized as indispensable:

Increased rate in: hyperthyroidism; exophthalmic goiter; thyroiditis; adenoma with hyperthyroidism (toxic adenoma); hyperpituitarism, acromegaly, gigantism; leucemia: lymphatic and myelogenous; anemia, when severe; malignancy, in about 30 per cent of cases; Hodgkin's disease; acidosis, when severe; diabetes, when moderate; arterial hypertension; fever: 7 per cent increase for each degree F. of rise of body temperature (DuBois); convalescence from wasting diseases, and rapid growth.

Decreased rate in: hyperthyroidism; postthyroidectomy; myxedema; cretinism; thyrogenous obesity; hypopituitarism; hypophyseal obesity; hypoadrenalism; Addison's disease in about 15 per cent of cases; undernutrition, starvation; epilepsy; arterial hypotension.

Normal rate in: obesity; endogenous obesity; goiter (without abnormal thyroid function), colloid goiter; adenoma, without hyperthyroidism; heart disease per se; nephritis, without hypertension; pregnancy, in most cases; menstruation (slight increase in the premenstrual period).

It is evident that the interpretation of a basal metabolism may be difficult except in cases where it confirms the clinical findings. An increased rate does not prove that a patient has a hyperthyroidism. A decreased rate is more definite evidence of a thyroid deficiency but desiccated thyroid must always be administered cautiously and in small doses until there is evidence from clinical improvement that the patient really needs this medication.

The obstetrician and the pediatrician are largely responsible for the prevention of thyroid disease. However, the majority of patients are

attended by the family physicians and the specialists must direct them in the prophylactic measures. Marine's contributions in this regard rank among the greatest in the field of preventive medicine.

It also seems probable from a purely theoretical point of view that measures directed toward the development of a normal thyroid may prove to be of value in securing a more normal development of other glands of internal secretion.

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INTRAUTERINE RADIUM THERAPY AS A CONSERVATIVE METHOD OF TREATMENT*

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IRRADIATION of the uterus may be utilized as either a conservative or radical therapeutic measure: conservative when effectively used in small dosage as a substitute for hysterectomy or other mutilating pelvic operations in the treatment of benign lesions; radical when applied in large dosage to malignant neoplasms, with incidental destruction of function. The elimination of the hazards involved in surgical procedures, with the prospect of equally satisfactory results in properly selected cases, are alluring features of the treatment of nonmalignant conditions with radium. Of course, a knowledge of the physics of radium, the possession of an adequate quantity of the element, familiarity with correct screenage and dosage, accurate diagnosis, and a clear conception of the subsequent histopathologic tissue alterations are requisite for its application. By virtue of his precision in pelvic diagnosis and his operative resources, the gynecologist is particularly well qualified to exercise discriminating judgment, unbiased by over-

Table I. Benign Uterine Conditions Treated With Radium

Fibromyoma	57
Fibrosis uteri, adenomyosis, and menopausal menorrhagia	27
Hyperplasia of endometrium	11
"Precancerous" endocervicitis	8
Induction of artificial menopause	4
Tuberculosis of uterus	2
Total	109

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enthusiasm on the one hand, and free from the temptation to commit the errors of the inexperienced on the other.

For purposes of review, it seemed desirable to confine the material selected to serve as the basis for this presentation to those patients for whom I can accept personal responsibility and whose follow-up has been supervised by myself, rather than to include all such cases treated in the gynecologic department of the New York Post-Graduate Hospital. From January 1, 1923, to January 1, 1932, I chose intrauterine radium therapy as the preferable method of treatment for 109 patients, whose

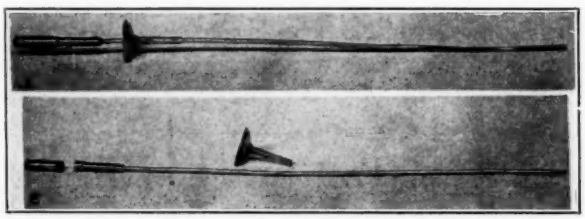

Fig. 1.—Radium applicator. *A*, assembled, *B*, disassembled.

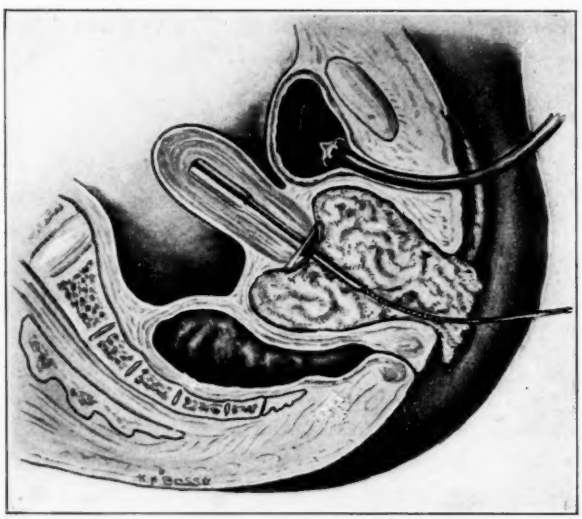

Fig. 2.—Intrauterine immobilization of radium without the use of sutures.

uteri were free from malignancy but would otherwise have required surgery (Table I).

TECHNIC

To insure homogeneous dissemination of the gamma rays throughout the uterus, I have designed an intrauterine applicator of nickel silver which conforms to the outline of the endometrial cavity and cervical canal, accommodating two radium tubes in tandem, and attached to a long flexible and malleable shaft. On the shaft there is a sliding aluminum collar with several perforations for drainage, originally devised by Willis, which can be pushed against the cervix after the applicator has been inserted into the uterine cavity (Fig. 1). The chamber for the radium tubes

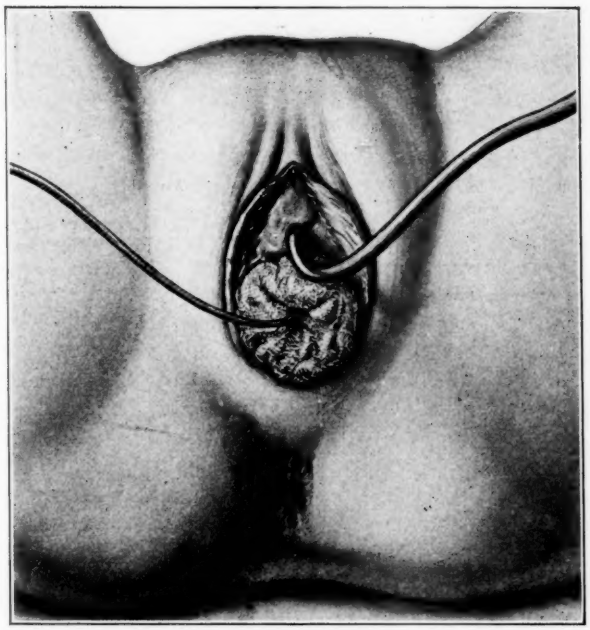

Fig. 3.—The gauze is packed into the vagina both in front and behind the applicator shaft and a Pezzer catheter placed in the bladder.

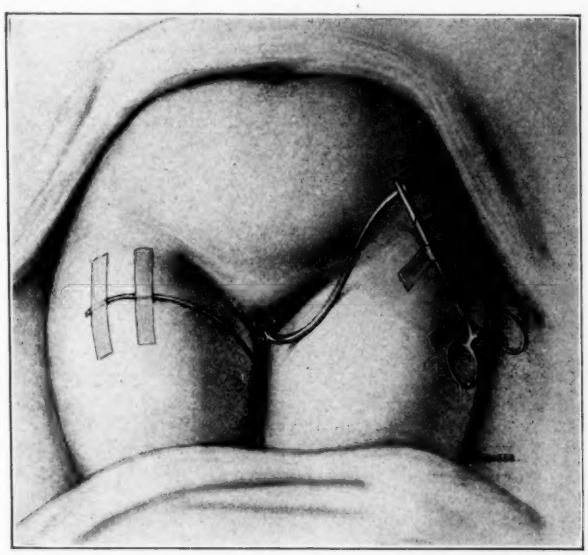

Fig. 4.—Applicator shaft strapped to the patient's thigh, with retention catheter clamped temporarily.

is 60 mm. in length and its walls are 0.5 mm. in thickness. The radium element is enclosed in 1 mm. of brass, so that the total metallic filtration used consists of 1 mm. of brass and 0.5 mm. of nickel silver. A rubber jacket may be slipped over the metal. The aluminum collar, together with tight vaginal packing, maintain the applicator firmly in position without the use of sutures (Fig. 2). The shaft is 300 mm. long, and thus will project sufficiently from the vaginal introitus so that it may be moulded to the contour of the thigh and secured with adhesive plaster (Figs. 3 and 4). Since the proper dosage for individual cases cannot be computed mathematically, it must be estimated by according due attention to the objective to be accomplished, the patient's age, marital state, and childbearing history, the constitutional condition, the size and bulk of the uterus, and the operator's past experience. Before applying radium the uterus should be curetted to determine the character of the endometrium and the outline of the uterine cavity, and especially to detect the presence of small fibromyomatous tumors and unsuspected early fundal carcinoma. Most cases of corporeal cancer are best treated by hysterectomy, and diseased adnexa and ovarian tumors also require extirpation. If there is any uncertainty as to the exact nature of the uterine pathology or any intraperitoneal indication for operative interference, the patient should be treated surgically.

FIBROMYOMAS

The 57 cases for radium therapy were selected in conformity with the prevailing opinion that subperitoneal, pedunculated, and degenerating fibroids, as well as those larger than a three months' pregnancy and those causing pressure symptoms, are not adapted to irradiation. Without exception, the tumors so treated were manifested by hemorrhage only. Thirty-nine patients were married, 10 single, and 8 widowed. Seven complained of incidental dysmenorrhea, and 4 had been previously curetted by other physicians without permanent benefit. Paralleling this group of radiated tumors, I did 34 myomectomies and 217

TABLE II. THERAPY SELECTED IN 308 CASES OF FIBROMYOMAS REQUIRING TREATMENT

	NO. OF CASES	PER CENT
Radium	57	18
Myomectomy	34	11
Hysterectomy	217	71
Total	308	100

TABLE III. RADIUM DOSAGE FOR FIBROMYOMAS

AGE OF PATIENT	NUMBER OF CASES	MINIMUM NO. OF MG. HOURS	MAXIMUM NO. OF MG. HOURS	AVERAGE NO. OF MG. HOURS
20 - 30	5	500	600	550
30 - 40	16	500	2400	1021
40 - 50	31	635	1800	1265
50 - 60	5	1200	2400	1635

hysterectomies for fibroids (Table II). It is therefore evident that less than 1 out of every 6, or 18 per cent of white patients with fibroids requiring treatment are suitable candidates for radium therapy. In general, the average dose was slightly increased in direct proportion to the patient's age, but less caution was exercised in cases in which the menopause had already been established or in which its artificial induction would nearly approximate the anticipated time of natural onset (Table III). No single dose larger than 1800 mg. hours was given, but in three cases the initial treatment failed to control the bleeding and a second dose was necessary. Another patient had developed a large bleeding fibroid nine years after an interposition operation and was irradiated to evade a difficult hysterectomy. The radium application alone proved inadequate and was afterward supplemented with x-ray therapy. In two other cases, although the bleeding had been satisfactorily arrested, the tumors progressively enlarged or degenerated during the ensuing two or three years, and were removed surgically. One patient returned after three years of normal menstruation, again complaining of menorrhagia, and was operated upon for an ovarian cyst. The dysmenorrhea was relieved in all patients who had menstrual pain.

FIBROSIS UTERI, ADENOMYOSIS, AND MENOPAUSAL MENORRHAGIA

The 27 cases arbitrarily placed in this category included those patients who suffered from inexplicable hemorrhage. Eighteen were married, 2 single, and 7 widowed. They were all free from evidence of constitutional disease, endocrine derangements, and detectable pathologic alterations in the pelvis. In each case the uterus was harder than normal and the curettings revealed nothing of significance. Endometrial gland proliferation into the myometrium is sufficiently common to justify the assumption that adenomyosis may have been responsible for some of these bleedings. One of these patients had been curetted three times by another physician without benefit. Another had been ineffectually treated with x-ray. Radium therapy was not advised for patients in this group until the possibilities of medical treatment had been exhausted. On the whole, they were older than those treated for fibromyomas, and the average radium dose was larger (Table IV). The

TABLE IV. RADIUM DOSAGE FOR FIBROSIS UTERI AND MENOPAUSAL MENORRHAGIA

AGE OF PATIENT	NUMBER OF CASES	MINIMUM NO. OF MG. HOURS	MAXIMUM NO. OF MG. HOURS	AVERAGE NO. OF MG. HOURS
30 - 40	6	500	1200	833
40 - 50	14	450	2200	1216
50 - 60	4	1200	1800	1425
60 - 70	3	1200	1320	1233

largest single dose given to any of these women was 1800 mg. hours, one patient requiring repeated dosage which totaled 2200 mg. hours.

HYPERPLASIA OF ENDOMETRIUM

It is noteworthy that 5 of the 11 patients with endometrial glandular hyperplasia had been curetted before coming under observation. In each instance there was transitory cessation of abnormal bleeding, followed by recurrence within a few months. Eight patients were married, 3 were single, and all were less than fifty years of age. Hyperplasia characterized by "Swiss cheese" endometrial glands, or glands tremendously distended with mucus, apparently tends to regeneration after simple curettage, and radium therapy or hysterectomy are necessary for cure. The controlling dosage in these cases was somewhat less than that used for fibroids and fibrosis (Table V).

TABLE V. RADIUM DOSAGE FOR ENDOMETRIAL HYPERPLASIA

AGE OF PATIENT	NUMBER OF CASES	MINIMUM NO. OF MG. HOURS	MAXIMUM NO. OF MG. HOURS	AVERAGE NO. OF MG. HOURS
20 - 30	5	450	1200	675
30 - 40	3	900	1200	1033
40 - 50	3	1200	1400	1266

"PRECANCEROUS" ENDOCERVICITIS

While I concur with those who contend that a given cervical lesion either is a cancer or it is not, when the biopsy specimen shows unusual epithelial proliferation or a suggestion of metaplasia, it seems rational to regard the tissue as predisposed to malignancy. In cases of this type, radium was applied as a prophylactic measure, using long platinum-iridium transfixion needles, either alone or with an intracervical applicator. All of these patients were married, none have developed cervical carcinoma up to the present time, and one subsequently was delivered of a healthy baby by cesarean section. Comparatively small doses can be used effectively (Table VI).

TABLE VI. RADIUM DOSAGE FOR "PRECANCEROUS" ENDOCERVICITIS

AGE OF PATIENT	NUMBER OF CASES	MINIMUM NO. OF MG. HOURS	MAXIMUM NO. OF MG. HOURS	AVERAGE NO. OF MG. HOURS
30 - 40	2	300	370	325
40 - 50	2	1200	1920	1560
50 - 60	3	720	1200	973
60 - 70	1	720	720	720

STERILIZATION

Radium therapy was used to sterilize four women, 1200 mg. hours being given to each one. The first was a patient of thirty-seven with diverticulosis, endocrine derangement, a pronounced neurosis, and moderate menorrhagia. The second was forty years old, suffering from recurrent hyperthyroidism two years after thyroidectomy, who had had an acute exacerbation after a therapeutic abortion two months previously. The third and fourth cases were women of twenty-eight and thirty-four years respectively, both of whom suffered from mitral stenosis and devastating cardiac decompensation during a previous pregnancy and labor, and who emerged as cardiac cripples. Each one had had two therapeutic abortions after the full term delivery, with exaggeration of the decompensation. The cardiac condition precluded tubal resection under general anesthesia and a low systolic blood pressure contraindicated spinal anesthesia.

TUBERCULOSIS OF THE UTERUS

Radium therapy was utilized in one case of tuberculosis of the endometrium. Both tubes and one ovary had been removed two years before, and the remaining ovary one year previously, by another gynecologist. The patient was only twenty-five years old and complained of constant bleeding. The curettings showed extensive endometrial tuberculosis, and the patient refused a third laparotomy. A single dose of 1200 mg. hours stopped the hemorrhage and the patient has remained well for the past seven years. In another case the radium was used inadvertently, a tuberculous lesion of the cervix being mistaken for a carcinoma. This patient was a single woman of forty-two, and the bleeding continued until a panhysterectomy was done. The diagnostic error was due to the fact that the cervical lesion grossly resembled a basal cell carcinoma although the biopsy specimens revealed nothing but "chronic endocervicitis." Only after the laparotomy was the correct diagnosis made.

BLEEDING OF PUBERTY AND ADOLESCENCE

This is mentioned simply to emphasize that these apparently idiopathic hemorrhages are nearly always due to endocrine imbalance and derangements of the hematopoietic system. Blood transfusions, organotherapy, calcium, and irradiation of the spleen with small doses of x-ray have arrested the bleeding in all but one of such cases coming under my observation. While radium therapy may be effective, it is unnecessary, unwise, and dangerous. If used at all, it should be applied in small graduated doses as a last resort.

COMBINED VAGINAL OPERATIONS

All patients in this series were curetted for diagnosis and four required a blood transfusion for severe secondary anemia. In addition,

simple vaginal operations, such as trachelorrhaphy, anterior colporrhaphy, and perineorrhaphy, were performed in many instances with satisfactory results. The radiation evidently has no deleterious influence on wound healing.

REPEATED DOSAGE

In three cases of fibromyoma, one of fibrosis uteri, and one of hyperplasia, the primary application failed to control the bleeding within six months, and a second dose was given. The stabilizing end-result of radium therapy in small doses is often delayed for several weeks and a complementary dose is best deferred until four or five months have elapsed.

INFLUENCE OF RADIUM THERAPY ON MENSTRUATION

A castration dose should be avoided whenever possible. It seemed particularly important to preserve the menstrual function in 27 women, and the largest single dose given to any of them was 750 mg. hours. Of these, 20 had normal menstrual periods reestablished within six months or less, and 1 after 18 months of amenorrhea. Thus, normal menstruation was successfully preserved in 78 per cent of such cases. On the other hand, an unexpected menopause was precipitated in 6 patients, but these disappointments were somewhat offset by the continuation of menstruation in 6 women who received more than 750 mg. hours.

INDUCTION OF ARTIFICIAL MENOPAUSE

The usual climacteric symptoms of flushes, sweats, and psychoneurotic disturbances appeared within six months in 37 of the 109 women treated with radium, but in only 16 were they prolonged or severe. The majority of those who stopped all bleeding did so after one or two periods with either mild or no menopausal symptoms. It would therefore seem that the carefully selected and moderate doses used in this series of cases succeeded in avoiding the abrupt ablation of ovarian function in most instances. I believe that this is due to the fact that the bleeding is checked by fibroblastic proliferation and compression of the blood vessels in the myometrium, rather than because of complete destruction of the secretory activity of the ovary.

LEUCORRHEA

Twenty-seven, or about 25 per cent of the patients, reported postradiation leucorrhea, apparently initiated by the treatment. All were kept comfortable with sodium bicarbonate douches, and the discharge ceased in less than six months in all but 4 cases.

EFFECT OF RADIUM THERAPY ON SEXUAL INCLINATIONS

Of the 77 married women treated with radium, 7 reported subsequent frigidity, but in one case this was only temporary. Two complained of vaginal dryness and a burning sensation on coitus, and another of

dyspareunia. On the other hand, 4 who had previously been indifferent experienced a marked and permanent stimulation of their amorous desires. To express it otherwise, there was no disturbance of the patient's domestic happiness in 87 per cent of cases.

SUBSEQUENT PREGNANCY

Three patients became pregnant and were delivered of normal babies.

The first was a woman who developed a small fibroid which caused metrorrhagia after fourteen years of sterility. She became pregnant six months after a radium application of 1100 mg. hours. The second was a woman of thirty-one, who had 2 children of seven and four years, and who became pregnant eighteen months after a 500 mg. hour application for a bleeding fibroid. The third was a woman of thirty, who came under observation during her first pregnancy. The cervix bled slightly but persistently from a local lesion, which two eminent pathologists pronounced "premalignant." She was delivered by cesarean section, and ten days later was given 370 mg. hours with transfixion needles. She became pregnant again two years afterward and was delivered by section a second time. This patient has been watched for six years and the cervix still appears normal. A fourth patient became pregnant three years after radium therapy, but aborted spontaneously.

POSTRADIATION COMPLICATIONS

There were no deaths in this group of 109 patients. The single complication noted was an intense uterine colic following a 600 mg. hour dose given for endometrial hyperplasia. This patient had received 300 mg. hours without untoward effects eighteen months prior to the second dose which excited the pain. Intermittent attacks of colic were very distressing for three weeks and then ceased.

CONCLUSIONS

1. Radium therapy is applicable as a conservative method of treatment in selected cases of fibromyoma, fibrosis uteri, endometrial hyperplasia, "precancerous" endocervicitis, and tuberculosis of the endometrium after bilateral salpingectomy. It is also serviceable for deliberate sterilization when laparotomy would be unduly hazardous.

2. About 18 per cent of white patients with fibroids requiring treatment are suitable candidates for radium therapy.

3. Larger doses of radium are necessary in cases of fibrosis uteri than for the treatment of fibroids.

4. Radium therapy is an excellent substitute for hysterectomy in cases of endometrial hyperplasia.

5. Transfixion needles, as well as intrauterine applications, are useful in the treatment of "precancerous" endocervicitis.

6. Radium therapy will arrest the bleeding from a tuberculous endometrium after tubal extirpation.

7. Radium therapy has little place in the bleeding of puberty and adolescence.

8. Radium therapy does not interfere with wound healing when vaginal plastic operations are performed simultaneously.

9. Repeated doses are necessary occasionally, but should not be given within six months.

10. The menstrual function will be preserved in 78 per cent of cases when the dose is 750 mg. hours or less.

11. The climacteric symptoms are no more pronounced after induction by radium than when the menopause occurs naturally. In fact, few patients complain of severe annoyance.

12. Radium therapy has a depressing effect on sexual inclinations in about 13 per cent of cases, but sometimes increases them.

13. Patients may bear normal babies after moderate doses of radium.

14. Radium therapy is free from mortality and particularly devoid of morbidity.

580 Park Avenue.

RESULTS WITH CORDOTOMY FOR RELIEF OF INTRACTABLE PAIN DUE TO CARCINOMA OF THE PELVIC ORGANS*

Francis C. Grant, M.D., Philadelphia, Pa.

(From the Neurosurgical Service of the University Hospital)

PAIN is the most distressing adjunct to disease. Any lesion malignant or benign can be endured until pain develops. But with its first appearance, the situation rapidly becomes intolerable. Tumors in and about the genitourinary tract, especially when malignant, cause pain through infiltration about adjacent nerves or by interference with urinary function. And this pain may be constant day and night wearing down strength and spirit. To relieve this intense, continuous and intractable pain the operation of cordotomy or section of the anterolateral columns of the spinal cord was devised.

In 1904, Spiller[1] confirmed by brilliant clinical observation the theory that pain-conducting fibers from extremities and trunk passed upward to the brain in the spinal cord by way of the anterolateral columns. He proved his contention conclusively in 1912,[2] when at his suggestion, Martin deliberately sectioned the anterolateral spinal tracts with complete abolition of appreciation of painful stimuli in all skin segments below the point of section. Spiller then turned to Frazier,[3] who developed the operative technic for cordotomy and placed the procedure upon a practical basis.

Pain whether unilateral or bilateral in any area below the ensiform can be permanently relieved by cordotomy. No more distressing group of patients is encountered than those doomed by intrapelvic malignancy to die painfully and slowly, riddled with morphine, waiting with as much fortitude as they can muster until death mercifully ends their sufferings. To these unfortunates, cordotomy can offer complete relief.

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*Read, by invitation, at the Fifty-Seventh Annual Meeting of the American Gynecological Society, May 30 to June 1, 1932, at Quebec, Canada.

Since 1916, 64 cordotomies have been performed upon 61 patients. In 25 cases the procedure was carried out for the relief of pain from pelvic malignancy. Sufficient material, therefore, is at hand to reach a definite conclusion as to the value of this operation.

The results of section of the anterolateral columns can well be illustrated by two cases.

CASE 1.—F. S., female, white, aged thirty-five. Pain persistent and severe running down right leg accompanied by weakness in leg. Panhysterectomy for uterine malignancy two years ago. Radiation treatment to limit of tolerance. Requires between 3 and 5 gr. of morphine a day to keep her comfortable. Left unilateral cordotomy September 10, 1930. No postoperative complications. Pain in right

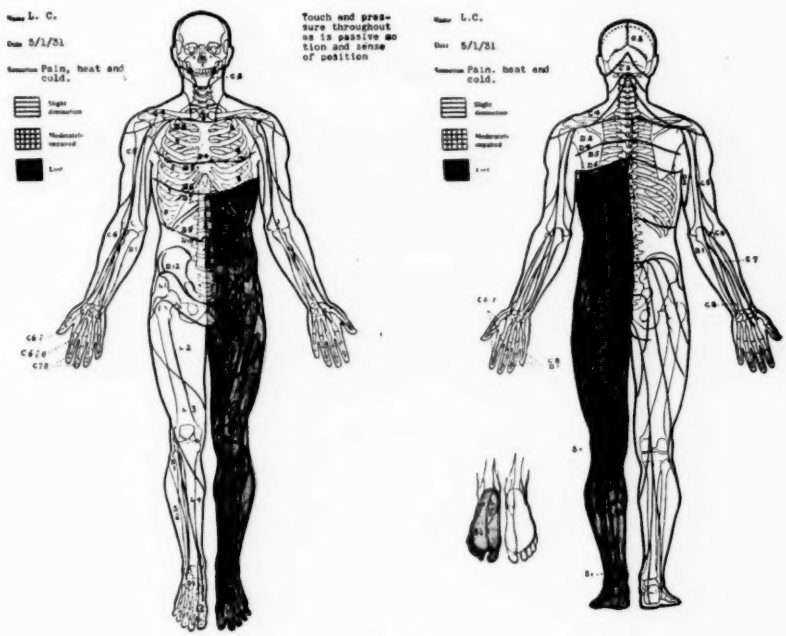

Fig. 1.

leg relieved. Morphine stopped seven days postoperatively. Reported in Follow-Up Clinic, April 11, 1931. At that time, she stated she had no pain in her leg. For two months after operation she had pain in the region of her coccyx and the sole of her right foot itched continuously. These sequelae disappeared and aside from an increase in the weakness of her right leg which was present before operation, her condition is entirely satisfactory. The muscular strength of the left leg is unimpaired.

CASE 2.—L. C., female, white, aged sixty-four. Severe, persistent, intractable pain in the left groin and extending down left leg. Panhysterectomy for cancer of fundus uteri, 1929. Evidence of pelvic metastasis upon vaginal examination. Radiation therapy to point of tolerance. Requires 3 to 4 gr. of morphine a day for relief of pain. Right lateral cordotomy in March, 1931. Complete relief of pain on left side until death in August, 1931. No morphine required after tenth day postoperative. Two weeks before death, pain appeared in the groin on right

side. Made comfortable by ½ gr. of codeine three times a day. Area of anesthesia is shown in Fig. 1.

These two cases represent clearly the value of cordotomy. Both were relieved of their pain and lived in comfort until the spreading malignant disease ended their lives. Without cordotomy their last days would have been a slow lingering battle with constant pain mingled with shortening periods of ease from ever increasing amounts of morphine.

Cordotomy has three distinct advantages over other methods of relieving pain. First, since in the anterolateral columns of the cord, the pain fibers are compactly collected, a section there produces the largest possible area of anesthesia. Secondly, pain and temperature sensations alone are obliterated without involvement of touch or position sense, and hence the usefulness of the lower limbs is not impaired. Lastly, the operation requires only a small laminectomy and is, therefore, a much less exhausting surgical procedure. But cordotomy has the disadvantage that unless the incision into the cord is accurately placed, the pain may not be completely relieved or the motor pathways may be damaged, resulting in paralysis of the legs and interference with sphincter control.

The technic of cordotomy presents but one difficulty. If the section of the cord is not accurately made the pyramidal tracts may be injured or insufficient pain fibers sectioned to give complete relief. By the use

TABLE I. ANALYSIS OF RESULTS FOLLOWING CORDOTOMY WITH RELIEF OF PAIN

61 Cases	64 Cordotomies	
37 Males	24 Females	
Bilateral cordotomy		34
Unilateral		30
Completely relieved		47
75 per cent relieved		10
50 per cent relieved		4
Not relieved		3

TABLE II. SUMMARY OF TYPES OF PAINFUL LESIONS REQUIRING CORDOTOMY

Malignancy of the genitourinary tract or genitalia	25
Malignancy of vertebrae	11
G. S. W. spine	4
Sarcoma hip	4
Retroperitoneal sarcoma	2
Painful stump	3
Tabetic crises	2
Osteoarthritis hip	2
Other causes	8

TABLE III. COMPLICATIONS FOLLOWING BILATERAL CORDOTOMY

Vomiting		4
Distention		6
Retention urine		10
Motor weakness		7
Died		6
Meningitis	2	
Shock	2	
Cachexia	2	

of gas oxygen, plus novocaine, it is possible to cut the pain tracts under local anesthesia and to determine with accuracy the level of loss of pain sensation by sensory tests carried out in the operating room. Muscle power in the leg on the side of the section can be tested at the same time. This is a distinct advance in technic that has practically eliminated any damage to motor pathways. Reference to Tables I to IV gives in detail the results with this procedure. In the last 18 cases, there has been no evidence of motor weakness in the lower limbs and no sphincter involvement lasting over three days. In all these cases the relief of pain has been complete.

The point of election for performing cordotomy is the fourth thoracic spinal segment, lying beneath the tip of the second and the body of the third thoracic vertebrae. At this level, the cord is readily accessible. A laminectomy of the second, third, and fourth thoracic spines affords sufficient exposure for a unilateral section, although if both tracts are to be cut, the fifth thoracic spine may be included as a larger exposure is needed.

TABLE IV. COMPLICATIONS FOLLOWING UNILATERAL CORDOTOMY

Vomiting		2
Distention		2
Retention urine		3
Motor weakness		2
Died		4
Cachexia	2	
Pneumonia	2	

METHOD

The day before the operation is to be performed, the patient is placed in the prone position and is rehearsed in the tests for pain sensation, especial emphasis being placed upon the differentiation between pain and touch. The surgical procedure consists in the removal of the appropriate lamina under gas oxygen anesthesia and novocaine infiltration. The bony edge of the vertebral canal on the side of the tract section should be cut well back for easier manipulation of the cord. The dura is opened and the point selected at which the anterolateral column is to be incised. A dentate ligament is grasped in a mosquito hemostat and the cord rotated posterolaterally. If a posterior root crosses the field, it is ligated, cut and retracted. The wound edges are now carefully packed with sheets of cottonoid saturated in one-half per cent novocaine. By this means perfect local anesthesia is obtained and the patient's attention is not distracted from the subsequent tests by pain in the operative field. The gas oxygen anesthesia is now stopped. The lower extremity upon the side to which the pain is referred is exposed for the testing of sensation. Time is allowed for the patient to recover entirely from the anesthesia, until replies to tests for pain sensation in the legs and feet are prompt and accurate. The cord is now rotated by traction on the dentate ligament and a very superficial incision made, barely sufficient to cut the pia, from just anterior to the attachment of the dentate forward to the lip of the anterior median fissure. Section of the pain tracts in the cord is not productive of pain stimuli, and may be done upon the conscious patient without causing distress. After this initial incision has been made, loss of pain sensation in the limb is determined. Usually after this first shallow section, pain stimuli about the foot and ankle are

abolished. The incision is now deepened, care being taken never to extend it posteriorly beyond the attachment of the dentate ligament. With each increase in the depth of the section, sensation is tested. The level of anesthesia to pain can be raised from the ankle to the knee, to midthigh, to Poupart's ligament, to the iliac crest, to the umbilicus and if necessary to the ensiform. But if the pain is referred to the perineum and down the leg, it is not necessary to push the sensory loss above the iliac crest. In this way, just sufficient pain fibers are cut to affect the necessary relief and little or no chance is taken of damaging the pyramidal tract. Furthermore, the muscular power of the leg upon the same side as the incision into the cord may readily be tested to determine whether or not motor pathways are being involved.

If the distribution of the pain indicates the necessity for a bilateral cordotomy, precisely the same procedure is carried out on both sides of the cord. It is important, however, not to cut both anterolateral tracts at the same level. One incision should be two segments above or below the other. After cordotomy has been performed, the wound may be closed under local or gas oxygen as occasion demands.

In deciding upon the necessity for a unilateral or bilateral cordotomy, a careful description of the distribution of the pain is essential. Occasionally patients have the more severe pain on one side with some distress upon the other, often so slight that it is overshadowed by the greater pain and not referred to in their story. But when the major pain is relieved, the minor remains and may later cause unexpected distress. It may be wiser under such circumstances to section both tracts, although the pain seems largely unilateral. If the malignant lesion is rapidly growing, and if the pain while still unilateral involves midline structures both anterolateral tracts should be cut to assure permanent relief. While bilateral cordotomy takes longer to perform than section of but one tract and has twice the chance of complications, nevertheless, in pelvic cancer it is often to be preferred as more certain in its results. In experienced hands, using the technic described, a bilateral cordotomy is but slightly more dangerous than a unilateral section.

Consideration of the 25 cases of cordotomy for pain from malignant disease of the pelvis proves the value of this procedure. In 15 a bilateral cordotomy was performed and in 10 a unilateral. Twenty-one patients were completely relieved, and 4 were considered much improved. Three of these subjects had a unilateral cordotomy with relief of pain, but the opposite side became involved before death occurred. Four patients died following operation. The average duration of life following cordotomy was seven months.

In cases of pelvic malignancy where the disease is sufficiently far advanced to cause pain, the decision for or against cordotomy is one of expediency. The operation is unquestionably sufficiently effective in its results to assure the patient complete relief from pain through the last months of life. And relief by cordotomy means complete relief, not the intermittent comfort afforded by morphine. It is our opinion that it is a merciful act to rid these poor people completely of pain even though it subjects them to major surgery and a week of postoperative

discomfort. Furthermore, as knowledge of the relief afforded by cordotomy is more widely appreciated, this operation will be recommended earlier to prevent pain from becoming the harassing factor it has all too often been allowed to develop into in the past.

REFERENCES

(1) *Spiller:* Univ. Pa. Med. Bull. **18**: 147, 1905. (2) *Spiller and Martin:* J. A. M. A. **58**: 1489, 1912. (3) *Frazier:* Arch. Neurol. and Psych. **4**: 137, 1920.

A NEW AXIS-TRACTION FORCEPS*

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IT IS with a great deal of reluctance that I presume to present to this Society such an instrument as a new forceps, and for this reason I feel called upon to explain in detail why I should do so. The birth of a new instrument of any kind (if we are completely honest) is brought about through selfishness, by which I mean that it is not through any desire to help the profession, but rather to help ourselves. To illustrate this point, I may be permitted to use my after-coming head forceps as an example. Some years before I had the first design of that instrument made, I had become convinced that the ordinary forceps, when applied to the after-coming head, were clumsy and rather difficult to use, but I had it firmly fixed in my mind that even that awkwardness was preferable to the method of indiscriminate traction on the fetal spine, neck, and shoulders. It seemed to me that I might be able to combine the blades of one instrument with the shank of another and the handle of another, and we could thereby accomplish the desired result. It did and it did not; but changing the instrument here and there gradually brought about some sort of a result, at least insofar as it is moderately satisfactory to me. But even now, after seven years, I am able to see changes that would be a distinct improvement, and the manufacturers are now working on the fifth model, which I trust will be the last. I find it rather amusing to receive the criticisms, which from time to time reach me, as to the manner in which the instrument should be changed. To most of these suggestions I give the only honest answer; which is, that the forceps were designed to suit me, and as they have accomplished that purpose, I can see no reason to change them.

It has been my experience that many of the strongest features of an instrument are either accidental or were designed for some other purpose. As an example of that: In the after-coming head forceps, the first model had a straight shank which I found made too much pressure upon the fetal body, so I had the dropped-shank put in and found that

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*Read at the Fifty-Seventh Annual Meeting of the American Gynecological Society, May 30 to June 1, 1932, at Quebec, Canada.

by so doing I had acquired a sort of axis-traction principle, which was of material benefit. Of course, it would be simpler to say that this was thought out originally that way, but the point is that it was not.

In regard to the axis-traction forceps which I am hereby presenting, I can only ascribe their designing to my lack of ability in using those forceps that are already on the market, and because I rather lean toward simplicity in mechanical devices. The three piece axis-traction forceps, of the various kinds and makes, have been a cause of a marked loss of temper on my part (surprising as that may seem), which was due to the fact that any metallic instrument which is subjected to repeated sterilization must of necessity impair the free action of metal-to-metal joints or metal thread connections as a result of rust, no matter how

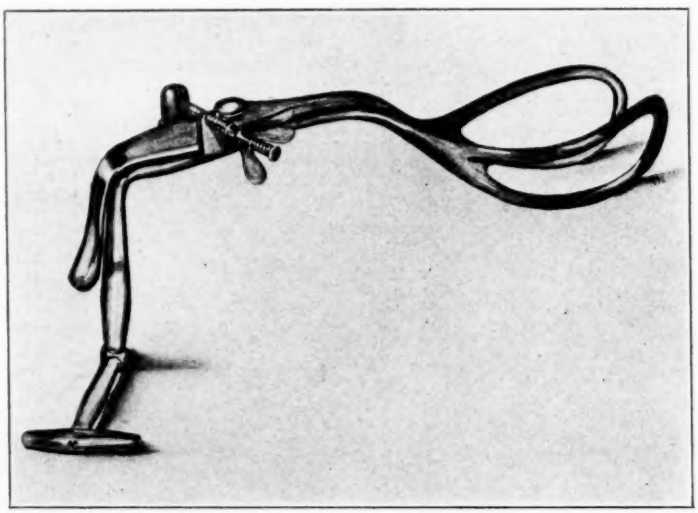

Fig. 1.

careful the nursing staff might be. The result of continually having this difficulty arise was that I acquired the habit of using one of the present-day forceps, namely, the Dewees axis-traction, by allowing the handle to rust tightly on the one blade and applying the blade with the handle already on. This naturally was rather clumsy, and so I had an instrument maker manufacture a pair with the handle and blade in a single piece, having a revolving joint in two places, so that the handle would drop down and not interfere during the application. From that beginning the present instrument was developed, by the slow process of trying it out and changing it here and there as seemed best.

To describe this forceps in detail: The cephalic curve is midway between the exaggerated flat curve of the Tarnier and the marked round curve of the Dewees. The plane of the curve is perpendicular to the plane of the shank at the point where they meet, which is in accordance with the usual construction of forceps and different from the after-coming head forceps. This is done to increase the rigidity of a forceps

in which traction is to be exerted, which in the case of the after-coming head instrument is not necessary, as the latter is designed as a flexor not a tractor. The shank is dropped and somewhat longer than the usual axis-traction but shorter than the after-coming head forceps. The shanks are of the overlapped variety with the French type of lock, with a swivel hinge and thumbscrew lock similar to many others. The extension of the shank of the left blade is bent approximately at right angles to a length at which the line of traction of the blade would pass through. At this point, the handle is put on by means of a swivel joint; the handle being the usual rod running to a larger rod and joined thereto by another swivel joint. The extension of the right blade is bent parallel and slightly beyond the left. This is rather immaterial and could be eliminated, and incidentally probably will be in later models.

This forceps has been used by myself and many others over a considerable period of time and under various conditions. Were I to say that it had never slipped, I would be making a silly misstatement of fact. Frankly, I have yet to see the forceps which fails to slip in my hands; the perfect application of forceps in all cases seems to be beyond the realm of possibility to me. However, when these forceps are put on correctly, there seems to be a rather marked increase in smoothness and power, and this I attribute to two things; namely, the type of cephalic curve and the drop shank. I have tried at various times to use an ordinary forceps and have exerted plenty of power, and have been unable to move the fetal head; upon removal of whatever forceps I might be using and the application of these forceps, I have delivered by the use of two fingers alone. Of course, the argument proposed there against this statement will be that I started the fetal head on its journey, making the work of these forceps much easier. The only answer I can give is that I know this not to be the case. There have been times when we have been confronted with the after-coming head of a breech, failing to engage properly at the brim or failing to come down, where there has been some engagement and the after-coming head forceps have been applied. As has been frequently stated, here and elsewhere, these after-coming head forceps were never designed as tractors and when applied to this type of case have been found to have too much spring and tend to slip. We have removed them, and applied the axis-traction forceps on the after-coming head and delivered a living baby. I merely say this in passing, and shall bring it up later.

The late Dr. J. Whitridge Williams was a firm believer in the obstetrician making himself expert in the use of one kind of forceps, and using that forceps in all kinds of cases. I should not presume in any way to criticize the attitude of Dr. Williams; in fact, I am rather coming a little bit more to that point of view, but there is only one way in which one can find out which type of forceps is particularly adapted to oneself, and that is by trying them all in one's younger days. And I have passed through that phase. At one time or anoth-

er, I have been quite enthusiastic over various types of forceps; I will not mention them by name, nor shall I mention those for which I had no enthusiasm whatever, because I do not care to tread upon anyone's toes. Also, I am fully aware that those forceps which I am incapable of using successfully, in the hands of others give eminently satisfactory results. Of course, the old Simpson forceps is the foundation of all modern forceps, and it is a pleasure to see them used in the hands of such experts as Barton Cooke Hirst, Joseph DeLee, and many others; but, the unfortunate thing is that so many so-called Simpson forceps are as far removed from the real Simpson forceps as the poles. We all know that DeLee, for instance, practically never uses an axis-traction forceps; that he is able by his manipulation to deliver all cases which should have forceps with the ordinary Simpson blades. For his ability to do this, he has my profound respect; I cannot.

To repeat, these forceps were designed for myself. In presenting them, it would have been easy to have worked out the angle of traction and to have made it correspond with the accepted pelvic inclination, but inasmuch as I seem to be an obstetric heretic, I have not done this. Herein lies the heresy: In all of the millions of inhabitants of the world, there are no two people who have faces exactly alike. From my experience with the female pelvis, I should surmise that were we able to calibrate all women's pelves we would not find any two exactly alike, and therefore all we can ever hope to achieve is the mean average, which is what we have tried to do in these forceps without bothering to work out any mathematical angles, etc.

It is a source of sad regret to me, that there is not present to pass judgment upon this instrument my old friend, Dr. John O. Polak, who did me the honor to try these forceps out for two months. I received a letter from him less than one week before his untimely death in which he commented favorably upon this instrument.

A little earlier in this paper, in referring to Dr. Williams and later to Dr. DeLee, I laid stress upon the fact that they both believed in the use of one pair of forceps only. Were I to confine myself to the use of one pair, I would use the instrument herewith presented because it happens to suit me, and frankly, it is almost as easily applied on the aftercoming head in a breech as the forceps which were designed for that purpose alone. I have used them with the head in all positions, or rather I should say the occiput, even with the head on the perineum, and have been able to deliver with less maternal injury than I would have caused with any other instrument. Allow me to reiterate, the forceps were designed for myself; anyone is privileged not to like them.

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(Abstracts of the discussions on the foregoing, together with the remaining papers presented at this meeting will be published in the November and subsequent issues of the Journal.)

Department of Reviews and Abstracts

Conducted by Hugo Ehrenfest, M.D., Associate Editor

Selected Abstracts

Carcinoma

Longo: The Hemoclastic Crisis as a Means of Diagnosis of the Malignant Tumors in the Sexual Sphere of Woman. Arch. obstet. e ginec. **17:** 1, 1930.

The subcutaneous injection of 1 c.c. of neoplastic vaccine prepared from fresh human malignant tumors has always provoked a marked leucopenia in women bearers of malignant tumors in the genital sphere.

Control investigations in women affected with other gynecologic diseases have constantly given a negative result.

Injection of the same vaccine in normal pregnant women in the second half of gestation has led to marked leucopenia in 40 per cent of the cases.

The author believes that the leucopenia following the injection of neoplastic vaccine may be used as a diagnostic sign. There must be a humoral analogy between pregnancy and organisms affected by malignant neoplastic disease.

Sydney S. Schochet.
Julius E. Lackner.

Vogt, E.: The Dangers of Biopsy and Diagnostic Curettement When Carcinoma of the Uterus is Suspected. Med. Klin. **27:** 1627, 1931.

Biopsy and curettement are minor operations but may at times be dangerous when resorted to in the presence of carcinoma. The chief risks involved are infection and spread of the carcinoma. Many authorities who use radium exclusively for the treatment of cancer of the uterus do not perform biopsies because of these dangers. The infections which follow diagnostic curettage may be local or general and the author cites cases of both kinds. His opinion is that biopsy may be dispensed with in most cases. However, where there is an early cancer, this small operation is necessary in order to be sure of the correct diagnosis.

Many attempts have been made to substitute other measures for biopsy. Hinselmann strongly advocates the use of the colposcope for this purpose. Schiller suggests scraping the epithelium of the portio and also the iodine reaction test. However, the latter test is not infallible.

The technic of biopsy is simple. In order to minimize the dangers however, it is best to use a sharp knife. The neighboring tissue should not be crushed and the wound edges should not be sutured. Bleeding can be stopped by packing the vagina. When performing a curettement, the uterus should not be pulled downward too strongly and the cervical canal should not be dilated more than is absolutely necessary.

The removed pieces of tissue should be examined microscopically without delay and if carcinoma is found, an operation should be performed or radiation therapy instituted immediately. The author emphasizes that the person who is to perform the biopsy or the curettement should be the same one who is to carry out the further treatment. Hence these minor operations should not be performed by general practitioners but by specialists.

Before biopsy or curettage is performed, the vaginal flora should be examined especially for streptococci. If the latter are found they must be removed by treatments before the operation is carried out. J. P. GREENHILL.

McNamara, W. L.: The Histologic Classification of Carcinoma of the Cervix as Regards Ultimate Prognosis. J. Lab. & Clin. Med. **15**: 976, 1930.

In an attempt to classify malignancy as "high" or "low" from microscopic examinations of biopsy material with special reference to prognosis, the author examined 294 cases of carcinoma of the cervix. The "low" group which included 15 cases is characterized by "pearl" formation and kerato-hyalinization, the cells being uniform in size and non-infiltrating. In the "high" group were found 276 cases. The cells of the cancers in this group are spindle-shaped, closely packed and contain much chromatin. Along with this type of cell is found a round cell with clear cytoplasm and a very highly chromatinized nucleus. This cell never invades tissue. There were three adenocarcinomas in the group but no data with reference to "high" or "low" malignancy can be given with respect to this group. After a three-year period, all cases found within this "high" group were dead. In the "low" group 12 out of 15 were still living at that time, three having died from other causes. Of the three in the adenocarcinoma group all were living after a three year period. W. B. SERBIN.

Warren, Shields: The Grading of Carcinoma of the Cervix Uteri as Checked at Autopsy. Arch. Path. **12**: 783, 1931.

Warren made a pathologic study in the grading of tumors based on observation at autopsy in 102 cases of carcinoma of the cervix uteri. The power of a tumor to metastasize has been arbitrarily taken as an index of its degree of malignancy. With such a criterion, the personal equation is largely eliminated. A modification of Broder's classification was used, dividing the epidermoid carcinomas on the basis of differentiation of the tumor cells, frequency of mitosis and relation of tumor to stroma into three groups: (I) of low malignancy; (II) of medium and (III) of high malignancy.

A comparison of the distribution of metastases in these 102 cases, shows a close correlation between the degree of malignancy as estimated by histologic grading and the distribution of metastases. Metastasis is uncommon in epidermoid carcinoma, Grade I and visceral involvement is very rare. In epidermoid carcinoma Grade III and in the adeno-acanthomas, metastasis to lymph nodes is the rule, and visceral metastases are common. So far as distribution of metastases is concerned, the degree of malignancy of epidermoid carcinoma, Grade II, and of adenocarcinoma of the cervix is approximately the same. Impairment of the renal function is the most common cause of death in cases of carcinoma of the cervix uteri.

W. B. SERBIN.

Kamniker, Hellmut: The Morphological Stage of Maturity of Uterine Carcinoma and Its Meaning in Operative Treatment. Zentralbl. f. Gynäk. **56**: 457, 1932.

During the years 1921-1925, 304 cases of carcinoma of the cervix were submitted to radical operation. Of this number, 254 cases had complete records and were available for statistics. When these cases were grouped according to their histologic classification it was seen that: of the solid carcinoma simplex, 133 (52 per cent); of the moderately mature epidermoid carcinoma, 73 (56.5 per cent); of the mature epidermoid carcinoma, 16 (50 per cent); and of the adenocarcinoma, 23 (48 per cent) were cured.

Of 49 cases of adenocarcinoma of the uterine body in 40 exact data were available, as follows: of the cases of solid carcinoma simplex, 3 (100 per cent); glandu-

lar carcinoma of low maturity, 18 (55 per cent); glandular carcinoma of medium maturity, 10 (50 per cent); glandular carcinoma of high maturity, 9 (78 per cent) were cured.

The author concludes that it is not possible to place a prognosis on the histologic picture of carcinoma of the cervix treated by radical operation. The clinical and not the histologic findings, as well as the radicalness of the operation decide the prognosis. The same thing holds true for adenocarcinoma of the body of the uterus.

WILLIAM F. MENGERT.

London, B.: Sarcoma of the Female Genitalia. Monatschr. f. Geburtsh. u. Gynäk. **89**: 194, 1931.

During the last eight years at the Breslau Woman's Clinic there were 1,368 cases of carcinoma but only 19 sarcomas (1.4 per cent). In the series of 229 myomas which were removed there were 8 cases of sarcoma, an incidence of 3.4 per cent. Parity plays no rôle in the etiology of sarcoma. The affliction is most common in the fifth and sixth decades of life.

Of the 19 sarcomas in this series 15 involved the uterus and 4 the ovaries. They were of the following types: round cell, spindle cell, giant cell, polymorphous cell, ripe cell and muscle cell.

The notion of older authors that muscle cells become converted into sarcoma cells is false. The term "sarcomatous degeneration" is likewise incorrect. Robert Meyer calls all sarcomas the cells of which have a resemblance to smooth muscle "sarcoma myocellulare."

The only certain way to diagnose a sarcoma is by microscopic examination and in many cases curetted material alone is not sufficient for a diagnosis. This is in contrast to uterine cancer.

Of the 19 sarcomas in the present series, 13 were subjected to operation. The clinical symptoms of sarcoma are not characteristic. In most cases however, there was bleeding, softening of the uterus, rapid growth, pain, bladder and bowel disturbances, loss of weight and cachexia.

There are two methods of treating sarcoma of the genitalia, namely operation and irradiation. The former does not yield good results because most patients die during the first year after operation. In the author's clinic every operable case is operated upon and later irradiated. The inoperable cases are treated with radium and roentgen rays.

J. P. GREENHILL.

Moulonguet, P.: Metrorrhagia After the Menopause Due to a Tumor or an Ovarian Cyst. Bull. de la Soc. d'obst. et de gynéc. **5**: 342, 1930.

In a monograph written in 1924, the author reported 50 cases of metrorrhagia which occurred after the menopause and which were caused by a tumor or a cyst of the ovary. Since that time he has operated upon five additional cases. In the service of Hartmann, he found 74 cases of cysts and tumors of the ovary among aged women and in 19 of these cases the tumors were associated with uterine hemorrhage.

The tumors of the ovary may be large and easily recognized or they may be very small and therefore easily overlooked. In 45 of 50 cases the tumor was benign and in only 5 cancer of the ovary was present. The bleeding which accompanies these tumors has a nervous or vascular origin and not an hormonal one. Frequently the uterine mucosa is hyperplastic and not senile in type.

The association of uterine hemorrhage and an ovarian tumor sometimes accompanied by ascites makes one feel that the condition is a malignant one and therefore hopeless. It is a mistake to think so, because an operation may be delayed when in reality operation will produce a complete cure.

J. P. GREENHILL.

Tietze, K., and Mayer, C.: Bleeding in Women Over 50 Years of Age. Monatschr. f. Geburtsh. u. Gynäk. **88:** 185, 1931.

From 1922 to 1930 the writers found at the Kiel clinic 376 cases of uterine bleeding in women past fifty years. These cases were divided into two groups. In the first were those who were either still menstruating or had had their menopause within one year. In the second group were those who had had an amenorrhea for at least one year.

In the first group there were 165 cases and the most important causes of bleeding were carcinoma 24.2 per cent, glandular hyperplasia 26.7 per cent, polyps 17.6 per cent, endometritis 10.3 per cent, myomas 7.9 per cent, and erosions 3 per cent. In the second group there were 211 cases and the most frequent causes of hemorrhage were carcinoma 66.4 per cent, polyps 12.3 per cent, glandular hyperplasia 3.3 per cent, erosions 6.7 per cent, endometritis 1.9 per cent, ovarian carcinoma and glandular hyperplasia 1.9 per cent. In 3.3 per cent of the latter series the diagnosis was not clear.

The above findings agree with those of other authors who made similar studies. Since cancer is so frequently the cause of bleeding in women past the menopause it should be the first thing to think of in these cases. A careful examination should be made not only by bimanual palpation but also by inspection. Furthermore if no definite information is obtained by this means, a biopsy of the cervix or a diagnostic curettement should be done. J. P. GREENHILL.

Zweifel, E.: Postclimacteric Metrorrhagia as Symptom of Carcinoma of the Uterus. Deutsche med. Wchnschr. **56:** 1388, 1930.

Patients entering the University Clinic in Munich with the complaint of genital bleeding, with an onset later than six months after menopause, were found to have carcinoma in 87 per cent of the examined cases. while patients suffering from metrorrhagia beginning in the first four months after menopause had cancer at the rate of 36 per cent. Thus the extreme importance is demonstrated for early and thorough examination in all cases of uterine bleeding, especially if of postclimacteric occurrence. G. E. GRUENFELD.

Bends, K.: Carcinoma of the Cervix After Previous Amputation of the Body of the Uterus. Monatschr. f. Geburtsh. u. Gynäk. **91:** 79, 1932.

Among 101 cases of portio and cervix carcinoma, Bends observed three cases of cancer in the cervical stump. In looking over his records of the preceding five years he found four additional cases. These seven cases occurred in a series of 515 cases of cervical cancer. Of the seven previous operations, six were abdominal supracervical hysterectomies and one was a vaginal amputation of the body of the uterus. The operations had been performed from eight months to eighteen years before detection of the cancer. The patients complained of hemorrhage and leucorrheal discharge. Two of the cases were operable, three were borderline, and two were inoperable. Six were squamous cell cancers and one was an adenocarcinoma. All of the cases were treated with radium, and after four and six weeks vaginal extirpation was performed on two cases. Of the seven women, two died of cancer, one is alive but incurable, and the remaining four are thus far free from recurrences.
J. P. GREENHILL.

Liepmann, W.: The Etiology of Carcinoma of the Cervix and Its Relation to the Trauma of Labor. Med. Klin. **27:** 846, 1931.

A series of 9,000 cases of cancer of the cervix was studied by Liepmann. He is of the firm belief that this disease particularly affects women who have borne children. He found among his own cases as well as among those reported in the literature that

an average of 90 per cent of all the cases of cervical carcinoma were in women who had had children. This frequency would be still larger if to their number would be added the women who had had abortions and those who had had some manipulation to the cervix in order to prevent conception. All these cases definitely indicate that trauma to the cervix plays an important rôle in the causation of cancer of the cervix. In the far less frequent cases of cancer of the body of the uterus other etiologic factors than injury must be sought. J. P. GREENHILL.

Keller, R.: Prophylaxis of Cancer of the Cervix. Bull. de la Soc. d'obst. et de gynéc. 2: 146, 1932.

Keller suggests certain rules for the prevention of cancer of the cervix. The cervix should be inspected for erosions in all cases where there is excessive vaginal discharge after a gonorrheal infection, after labor and where there are irregular scars of the cervix. All erosions or cervical metritis should be treated by cauterization with silver nitrate or the electric cautery without removal of the cervix. If the erosion persists in spite of this therapy, the cervix should be amputated low down and a careful plastic operation be performed on the external orifice of the cervix to be sure that the mucosa of the cervix and the mucous membrane of the vagina are properly brought together. The excised portion of cervix should be examined microscopically. Each recurrence of erosion should be treated in the same way. J. P. GREENHILL.

Sampson, J. A.: Implantation Peritoneal Carcinomatosis of Ovarian Origin. J. Path. 7: 423, 1931.

The purpose of this paper is to present the evidence that implantation peritoneal carcinomatosis of ovarian origin is nothing more than the result of the repair of injuries to the peritoneum caused by cancer cells which have escaped from ovarian tumors into the peritoneal cavity and lodged on the surface of its serous membranes together with the continued growth of these cells in this situation. The material of Sampson was obtained from 25 cases of peritoneal carcinomatosis associated with ovarian cancer. Twenty of the 25 tumors were either carcinomatous ovarian cysts or cystic adenocarcinomata. Fifteen were bilateral.

The author found that in the repair of the injuries to the peritoneum, the various stages as well as the laws governing the same are similar to those encountered in the repair of tissues injured by foreign bodies, and the taking of skin grafts—namely the healing of wounds. The histologic structure of these implants varies with the reaction of the peritoneal tissues before and after the fixation of the cancer cells and the activity of the latter. As a result cancer becomes embedded in the peritoneal scar, encapsulated on its surface, enmeshed in adhesions, or like the epithelial growth of a successful skin graft spreads over the peritoneum without encapsulation. The malignant cells of these metastatic tumors possess the same potentialities of invasion and dissemination as those of a primary cancer. J. P. GREENHILL.

Höpper, H.: Adenofibrosis Retrocervicalis and the Question of the Late Transition to Carcinoma. Monatschr. f. Geburtsh. u. Gynäk. 87: 536, 1931.

The author describes a case of adenofibrosis retrocervicalis which spread to the parametrium and rectum. Eleven years later this became carcinomatous. The diagnosis was made on the clinical course and the clinical examination. Biopsy of a portion of the growth removed from the posterior vaginal wall verified the diagnosis. The histologic diagnosis was adenocarcinoma. Treatment consisted of radiation of the ovaries and the tumor by means of roentgen rays and mesothorium. The patient has remained well for eight years after this treatment.

J. P. GREENHILL.

Item

American Board of Obstetrics and Gynecology

Attention is called to the following requirements for those who desire to be enrolled in the organization.

APPLICATION AND CERTIFICATION

Formal application must be made upon a blank which will be supplied by the secretary. A booklet outlining requirements in detail will also be sent on request. This latter describes the necessary credentials and qualifications of the applicant, defines the limitations of the specialty, and gives general information, as well as a list of certificate holders so limiting their work.

Applicants are classified as follows: Group A. Those who have limited their practice to obstetrics and (or) gynecology for a period of ten years or more, having had adequate special training. Group B. Those who have had: 1, at least one year of interne service; 2, five years or more of practice thereafter, including at least three years of special training in obstetrics and (or) gynecology satisfactory to the Board of Directors; 3, and who are now limiting their practice to obstetrics and (or) gynecology. The details of their respective examinations are outlined in the booklet.

The application or examination fee is used entirely for administration expenses. None of the members of the Board receive any compensation for their services. Considerable time and effort is constantly being contributed by the members of the Board, and the assistant examiners.

Older and well established obstetricians and gynecologists will consider it an obligation, it is hoped, to apply for and obtain the certificate in order to promote the efforts of the board by their example and their active participation in its work. It is rapidly coming to be looked upon as a necessity for the younger man who wishes to be established and recognized as a specialist in obstetrics and gynecology.

ANNOUNCEMENT OF EXAMINATION

The next written examination of the American Board of Obstetrics and Gynecology will be held on Saturday, October 22, at 2 p. m., in 19 different cities of the United States and Canada (see announcements). In order to reduce traveling expenses for candidates, special arrangements may be made through the Secretary for taking the written examination at any city other than those regularly specified where there is a Diplomate who can be empowered to conduct the examination. This arrangement does not apply to the general, clinical examination to be announced later. For further information address Dr. Paul Titus, Secretary, 1015 Highland Building, Pittsburgh, Pa.